AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1 | 2

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO.(If applicable)
0004	09-Jul-2002	W26GLG-2091-4923	

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than item 6)	CODE
CONTRACTING OFFICE (CA/CW) US ARMY ENGR DIST NORFOLK ATTN: CENAO-CT 803 FRONT STREET NORFOLK VA 23510-1096	DACA65	**See Item 6**	

8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)		
	X	9A. AMENDMENT OF SOLICITATION NO. DACA65-02-R-0012
	X	9B. DATED (SEE ITEM 11) 17-Apr-2002
		10A. MOD. OF CONTRACT/ORDER NO.
		10B. DATED (SEE ITEM 13)
CODE / FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

[X] The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer [ ] is extended, [X] is not extended.

Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS.
IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

[ ] A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.

[ ] B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).

[ ] C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:

[ ] D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor [ ] is not, [ ] is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

AMENDMENT NO. 0004 TO DACA65-02-R-0012, Aerial Delivery and Field Services Training Facility, Fort Lee, VA.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
15B. CONTRACTOR/OFFEROR _____ (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY _____ (Signature of Contracting Officer)	16C. DATE SIGNED 09-Jul-2002

SECTION SF 30 BLOCK 14 CONTINUATION PAGE

Plans and technical specifications are amended. Make appropriate changes in accordance.

AMENDMENT 4 ***July 9, 2002***

The Documents are amended as follows:

Drawings:

All drawings have been reissued.

Specification Section

Section 01005- paragraph 1.3, **Change** "will" to "shall" in the 3rd and 5th line.
paragraph 1.3, on the last 2 lines, **Change** "Safety Plan (Accident Prevention Plan" to "Accident Prevention Plan as required in Section 01111, Safety and Health Requirements".
paragraph 1.6.5, **Delete** "NDE may contact DEL POC Tim Richardson (804) 734-4714."
Add paragraph "1.4.3 Contractor Material and Supply Delivery Restrictions. The Contractor shall avoid material and supply deliveries during rush hour traffic times, normally 0600 – 0900 and 1600 – 1800. If the project schedule requires delivery during these rush hour traffic times, the Contractor shall make arrangements with the Provost Marshall to expedite those vehicles. This would be particular for concrete truck deliveries since an extended delay of over 45 minutes could result in rejection of the material at the job site.".
paragraph 1.5.4, last line, **Change** the telephone number to read "(1-800-552-7001) and **Add** "a minimum or 48 hours prior to digging.".

Section 01111 paragraph 1.4, **Change** title to "ACCIDENT PREVENTION PLAN".

Section 01200 paragraph 1.3, **Change** items a – d to read "a. initial Coordination Meeting: See Section 01451, CONTRACTOR QUALITY CONTROL., b. Quality Control Plan: See Section 01451, CONTRACTOR QUALITY CONTROL. c. Accident Prevention Plan: See Section 01111, SAFETY AND HEALTH REQUIREMENTS. d. Environmental Protection Plan: See Section 01560, ENVIRONMENTAL PROTECTION PLAN (PROJECT SITE). e. Warranty Management Plan: See Section 01780, CLOSEOUT SUBMITTALS. f. Monthly Coordination Meeting: See Section 01312, RESIDENT MANAGEMENT SYSTEM (RMS). g. Periodic Progress Meetings: See Section 01312, RESIDENT MANAGEMENT SYSTEM (RMS).

Section 01320 paragraph 3.5.2.8, **Add** "Phase 1: Contractor shall complete and make available for use the New Running Track and field before the existing track is removed from Army use. Phase 2: Remainder of the project."

Section 01330- paragraph 1.2 Fabrication and Placement and Test Reports, **Add** to the submittal register the "G" government classification approval of Section 03301 requiring SD-02, SD-04, SD-06, and SD-07 level submittals.
Add to the submittal register the "G" government classification approval of Section 10990 requiring SD-02 and SD-03 level submittals for Chair Lift and Glass Rail. Include SD-10 submittal for Chair Lift.

Section 01451- paragraph 3.4.3, **Change** first sentence to read "In addition to CQC personnel specified elsewhere in the contract documents, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: Electrical, mechanical, and submittals clerk."

Section 01500- **Add** the attached sign plates to the end of the specification.

Section 01561N- **Add** the attached Storm Water Package to the end of the section.

Section 01850- **Delete** the Section.

Section 02315, - paragraph 1.2.1, first sentence, **Delete** "and SC" and Add "SC" after "GC," in the second sentence. Add a new third sentence "For structural fill materials, the liquid limit shall be less than 25 and the plasticity index shall be less than 12, when tested in accordance with ASTM D 4318."

Section 02510- paragraph 2.1.1.3 Polyethylene (PE) Plastic Piping. **Change** "Pipe and heat-fusion fittings shall conform to AWWA C906." to read as follows: "Polyethylene (PE) plastic piping shall not be used."
paragraphs 2.1.1.4, 2.1.1.5, 2.1.2.2, 2.2.1.1, 2.2.1.3, 2.2.1.4, 3.1.2.4, 3.1.4, 3.1.4.1, **Delete** "[Enter Appropriate Subpart Title Here]"

Section 02531a paragraphs 2.1.2, 2.1.2.1, 2.2.2, 2.3.2, **Delete** "[Enter Appropriate Subpart Title Here]".

Section 02555a- paragraph 1.2, last sentence, **Change** to read "The system is designed for an operation pressure of 125 psig and an operating temperature of 100 degrees F."
paragraph 3.6, **Delete** "or Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL".

Section 02630N- paragraph 2.1, 2.1.3, **Delete** "[Enter Appropriate Subpart Title Here]"

Section 02742N- paragraph 1.1, page 1, under references, **Add** to "latest VDHT RBS shall be used".
paragraph 3.11, **Delete** "SD-17 Sample Installations".

Section 02763A- **Change** to pavement markings paragraph 1.2, page 1, SD-06 test reports. Sampling and testing shall have a "G".
Delete the following paragraphs: 1.4.1 thru 1.4.5, 1.5, 1.6, 2.2 thru 2.3, 235.2.5, 2.6, 3.1 thru 3.2.1.2, 3.2.3 thru 3.3.

Section 02770A- Delete paragraph 1.2 and 1.2.1.
Change to paragraph 1.3 page 2, SD-06 test reports. Field quality control shall have a "G".

Section 02935- Delete paragraph 2.1.11.
Add the FORT LEE POLICY NO. 34-01as an attachment to the specification.

Section 03301- Delete paragraphs 3.1, 3.2, 3.3, 3.4, 3.5.

Section 04200A- Change paragraph 2.13.a and b to read "a. Copper Coated Flashing: Electro sheet copper not less than 5 ounces, factory coated both sides with acid and alkali resistant bituminous compound not less than 6 ounces per square foot or factory covered both sides with asphalt saturated cotton fabric, asphalt saturated glass fiber fabric, or with 40 pound reinforced kraft paper bonded with asphalt. b. Stainless steel, Type 304 not less than 0.01 inch thick, completely encased by and permanently bonded on both sides to 50 pound high strength bituminized crepe kraft paper, using hot asphalt, heat, and pressure."

Section 05400a- paragraph 2.1 b. (1). **Change** to read "Studs and Tracks: stud thickness as noted on drawings. Track thickness as recommended by manufacturer."
paragraph 2.1 b. c., **Delete** 3-5/8, 4 inches

Section 08710- Add the following information. Change the lockset on doors- 104A, 105A, 106A, 106C, 107, 108, 109, 110, 111, 112, 113, 116B, 118, 134C, 136B, 137, 138B, 139B, 140, 141, 142, 144B, 148C, 203, 216, 217, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 232, 233, 234, 236, 238, 240, 242B, 250, 251, 252, 254, 255, 258B, 261, 263, 264A, 265, 266B, 269, 270, 271B, 272, 273- to electronic car reader lock system. System shall include a mortised electronic lock set on each door as indicated above, have key override, battery power, proximity reader, and lever handle to match other hardware. Include all necessary accessories for a complete, functional and maintainable system. Accessories shall include software, programming cable, palm type device for programming locks and transferring information, encoder (to be attached to the Government's computer), and 400 extra cards. System shall be approved equal to Best Access Systems HBV with a FV function. Key cylinders shall be furnished by the Government and installed by the Contractor at the end of the project. System shall be provided in accordance with other portions of the specification including submittals.
Delete doors 143B and 146B from the Hardware Schedule.
Change door hardware in the Hardware Schedule for door 278 from 9 to 18.
Change paragraph 2.3.7 to read "Government shall provide Best core cylinders for new locks, including locks provided under other sections of this specification. Cylinders shall be interchangeable and removable with special control key. Tumblers shall be 6-pin, G keyway. Contractor shall provide construction cores. Contractor shall install Government furnished permanent cores at completion of the project.

Section 08520- **Add** to the end of paragraph 1.2.1, "To meet Antiterrorism Force Protection requirements frames, mullions, and window hardware shall be resist a static load of 1 pound per square inch applied to the surface glazing. Frame and mullion deformation shall not exceed 1/160 of the unsupported lengths. The glazing shall have a minimum frame bite of 3/8 inch for structural glazed window systems and 1 inch for window systems that are not structurally glazed. Frame connection to surrounding walls shall resist a combined loading consisting of a tension force of 200 pounds per inch and a shear force of 75 pounds per inch."

Section 08810a- **Add** to the end of paragraph 1.3, "To meet Antiterrorism Force Protection requirements frames, mullions, and window hardware shall be resist a static load of 1 pound per square inch applied to the surface glazing. Frame and mullion deformation shall not exceed 1/160 of the unsupported lengths. The glazing shall have a minimum frame bite of 3/8 inch for structural glazed window systems and 1 inch for window systems that are not structurally glazed. Frame connection to surrounding walls shall resist a combined loading consisting of a tension force of 200 pounds per inch and a shear force of 75 pounds per inch."

Change paragraph 2.2.1 Low-E Insulated Glass to read, "Insulated glass units for windows and curtainwall shall consist of an exterior pane of ¼"annealed (except where tempered is required by code) coated flat bronze tinted glass and an interior pane of 3/8" clear laminated glass. Insulated glass units for doors shall consist of an exterior pane of ¼" tempered clear flat glass and an interior pane of ¼" clear laminated glass. Glass shall conform to ASTM C 1036. Glass color shall be equal to Viracon VT-4-30. Glass shall have a low-emissivity coating on the number 2 surface. Laminated glass shall have an inner bonding layer of 0.030-inch polyvinyl-butyral (PVB).

Add to the end of paragraph 2.4.1, "Spandrel glass shall be 3/8" thick.

Section 08900- **Add** to the end of paragraph 1.5.5, "To meet Antiterrorism Force Protection requirements frames, mullions, and window hardware shall be resist a static load of 1 pound per square inch applied to the surface glazing. Frame and mullion deformation shall not exceed 1/160 of the unsupported lengths. The glazing shall have a minimum frame bite of 3/8 inch for structural glazed window systems and 1 inch for window systems that are not structurally glazed."

Section 09915- **Clarify** paragraph 2.2.2- color of aluminum doors and doorframes, hollow metal doors and frames, overhead rolling door, windows, fascia, louvers and flashings shall be dark bronze. These materials shall all match.

Change paragraph 2.2.6.d to read "Acoustical Wall System: AWS: Whisper Wall Panel System finish shall be selected from submittals of the manufacturers standard product meeting the specification."

Section 09685N- **Change** paragraph 3.1.2 "Furnish one carton of carpet tiles" to "Furnish extra tiles equal to 10% of the installed quantity".

Section 09915- **Change** paragraph 2.2.6.i "Mortar: White." to "Mortar shall be selected from Contractor's submittals to match gray and coral colored block."

Section 10100A- **Change** paragraph 1.3 under SD-03 Product Data to read "Markerboard; G, Tackboard; G, Projection Screen; G, Visual Aid Board Unit; G and Bulletin Board Case; G.

Add to paragraph 2.3 "MARKERBOARD (Locate one at 4 feet high x 10 feet wide in room 264. Locate two at 4 feet high x 16 feet wide in each room number 134, 136, 137, 138, 144, 148, 250, 251,252, 254, 255, 258).

Add to paragraph 2.4 "TACKBOARDS (Locate two 4 feet high x 6 feet wide tackboards in each room 271 and 272. Locate one 4 feet high x 4 feet wide tackboard in each room 107, 239, and 265)

Add paragraph "2.6 VISUAL AID BOARD UNIT (Locate one unit in each room 106, 242, 266) The visual aid board unit shall be 4 feet high x 6 feet wide. Unit shall be a wall-hung cabinet with lockable double doors. The doors shall be attached to cabinet with piano hinges and have a catch or closure to keep doors closed when not in use. The interior of the cabinet shall contain a porcelain enamel marker board writing surface with chalk tray, a flip chart that can be hung on an interior door panel, and fabric covered tack surface on the interior door panels. The cabinet shall be light oak hardwood. The edge detailing shall be rectilinear. Dry erase markings shall be removable with a felt eraser or dry cloth without ghosting. Two keys, an eraser and set of markers shall be provided for each unit."

Add paragraph "2.7 BULLETIN BOARD CASE (Locate one case in Room 107)
Case shall be 4 feet high x 6 feet wide. Frame and trim shall be 1-1/2" x 3" heavy-gage rectangular aluminum with bronze anodized finish. Design standards shall be Claridge model 3037. Single glass door shall be fitted with flat key tumbler lock and hung on piano hinge. Provide 3/16" thick tempered glass door. Provide tack able surface back panel with fabric wall covering finish to match other tack boards on this project.

Installation and assembly shall be in accordance with manufacturer's printed instructions. Concealed fasteners shall be used. Visual display boards shall be attached to the walls with suitable devices to anchor each unit. The contractor shall furnish and install trim items, accessories and miscellaneous items in total, including but not limited to hardware, grounds clips, backing materials, adhesives, brackets, and anchorages incidental to or necessary for a sound, secure, complete and finished installation. Installation shall not be initiated until completion of room painting and finishing operations. Visual display boards shall be installed in locations and at mounting heights indicated. Visual display boards shall be installed level and plumb, and if applicable doors shall be aligned and hardware shall be adjusted. Damaged units shall be repaired or replaced by the contractor as directed by the contracting officer."

Section 10270A- **Add** new paragraph as follows:

"1.2.8 Manufactured Wiring System
Electrical power and communication outlets and related assemblies shall be fully coordinated and compatible with the raised floor system with respect to fit, component dimensions and floor covering. System shall conform to UL 183, Modular Wiring Systems, NFPA 70, National Electrical Code, Article 604 and EIA/TIA 568A Commercial Building Telecommunications Cabling Standard. System shall be modular and consist of flexible type power cable assemblies, distribution boxes, cable connectors, service center outlet assemblies with power receptacles and telephone outlets. System shall be constructed in such a manner to allow ready connection and reconfiguration via plug and receptacle type cable connectors. System shall include all accessories for a complete and functional system.

1.2.8.1 Power Wiring
Power wiring shall be multi-conductor type MC cable, No. 10 AWG, with 600V THHN 90 degree insulation. Cable shall include general purpose and isolated ground as well as phase and neutral conductors, color coded to properly identify each conductor. Provide cable connectors suitable for interconnecting service-center boxes and pre-fabricated under-floor cables to building power system.

1.2.8.2 Communications Wiring
Communications wiring shall be Category 5e, four pair, UTP and bundled for under-floor routing to the communication closet backboard. Under-floor multi-user telecommunication consolidation point hardware may be used to facilitate connection of communication facilities where provided in accordance with EIA/TIA standards.

1.2.8.3 Distribution Boxes
Distribution boxes, where required shall be two compartment and constructed of 16 gage cold rolled steel with powder coat paint finish. Mounting support legs shall be provided. Box shall be fitted with power and cable connectors for the circuiting requirements indicated. Boxes shall be equipped with grounding lug.

1.2.8.4 Service Center Floor Outlet Box
Service center box shall be constructed of 14-gage steel with protective coating of powder coat paint, galvanizing or equivalent. Boxes shall provide general purpose 120 volt power and communication service to indicated locations and shall be provided with duplex power receptacles and modular Category 5e telephone jacks as indicated."

Section 10990- **Add** paragraph "2.7 TRUCK DOCK BUMPERS. Bumpers shall be laminated rubber. Rubber shall be recycled tire rubber. Support shall be galvanized steel angles. Provide 2 side bumpers (12" wide x 24"high) and one center bumper (24" wide x 12" high)."

Add paragraph "2.8 CHAIR LIFT. Lift shall be located at the Auditorium Stage. Coordinate to fit into the 4'0" wide x 4'6" deep opening. Lift manufacturer shall have no less than 5 years experience manufacturing similar equipment. Lift shall be the "straight Through Access" type, floor mounted, using a 120 volt/15 amp dedicated circuit, electric drive, 550 pound capacity, 8 feet per minute minimum speed, metal platform (finished with carpet to match room). Unit shall include all options and safety features as required by code for proper operation. Mechanical tower shall be located against the exterior wall. Provide gate at lower level finished with wood panels on public side to match the stage. Paint all exposed metal to match adjacent materials. Specification based on RAM Manufacturing & Trus-T-Lift product. All work shall be in accordance with the manufacturer's printed recommendations."

Add paragraph "2.9 GLASS RAILING. Glass rail system shall be structural with extruded aluminum base approximately 5 inches high and 3 inches wide, polished stainless steel cladding on both sides of the base, ¾" tempered glass, polished stainless steel cap rail (2 1/2" diameter) and all necessary accessories for a complete installation. Stainless steel shall be type 304 (18-8) tubing meeting ASTM A 269, ornamental grade, and

polished to an ANSI # 7 finish. Provide mitered corners and end caps. Anchors shall be cast in the concrete slab. Extruded aluminum base shall be alloy 6063-T52 meeting ASTM B 221 and safety requirements of ANSI A21.1. Glass shall be polished clear tempered. All work shall be in accordance with the manufacturer's printed recommendations."

Add under paragraph 1.2 SD-03 submittals "Chair lift; G and Glass rail; G.
Add under paragraph 1.2 SD-10 submittals "Chair Lift; G".

Section 13100A- Paragraph 3.1.1- **Change** first sentence to read "The lightning protection system shall consist of air terminals, roof conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground."

Section 13100A- Paragraph 3.1.1.4- **Replace** first sentence with "Provide grounding electrodes as indicated on the drawings."

Section 13100A- Paragraph 3.1.3- **Delete** paragraph and subparagraph in their entirety.

Section 13851A- Paragraph 2.5.2.3- Next to last sentence, **Change** referenced specification from "Section 15950 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS" to "Section 15951 DIRECT DIGITAL CONTROL FOR HVAC"

Section 15080A- Paragraph 3.2.2.1 **Change** Insulation Thickness- Line up numbers correctly

Section 15400A- Paragraph 3.12 TABLES. **Change** under "Table II" section - line up "X's" correctly under item #9.

Section 15569A- Paragraph 2.1 BOILERS. **Delete** the word "firetube" and replace it with "watertube".

Section 15569A- Paragraph 2.1.1 Firetube Boiler. **Delete** entire section and replace it with watertube section. In the bracket area choose "bent or flexible"

Section 15569(rev), Appendix A- Add the following PVF forms:

1. Pumps
2. Air Cooled Chiller
3. Hot Water Boiler
4. Heaters
5. Variable Volume Air Handling Unit
6. VAV Terminals
7. Single Zone Air Handling Unit
8. Fans, Exhaust and Supply
9. Automatic Glycol make up system
10. Radiation

Section 15990A- Paragraph 3.5.1 TAB Procedures. At the end of the paragraph **Add** the following: "The following tolerances shall apply to the testing and balancing procedures; +1-5% for air and water flow at individual devices and 0 to +10% for system air and water flows".

Section 15995A- Delete entire section and replace with attached "SECTION 15995(REV) COMMISSIONING OF HVAC SYSTEMS"

Section 16113A- Add new specification "SECTION 16113A UNDERFLOOR DUCT SYSTEM" per attachment.

Section 16375A- Paragraph 1.3 SD-06, Field Testing- **Delete** bracketed information and substitute "30" days.

Section 16375A- Paragraph 2.8.2.1- **Delete** all references to "kA" and replace with "Amperes"

Section 16375A- Paragraph 2.9.1.2- **Delete** brackets and substitute "17kV" for Rated Maximum voltage and "12000A" for Maximum symmetrical interrupting capacity. Delete "200A" and replace with "As Indicated" for Rated continuous current.

Section 16375A- Paragraph 3.6.3- **Delete** last sentence "Cables for the telephone and communication systems will be installed by others" in its entirety.

Section 16375A- Paragraph 3.8- In the second sentence, **Delete** brackets and word "guards".

Section 16415A- Add new paragraphs as follows:

"2.12.6 Digital Lighting Dimming System

2.12.6.1 Digital Dimming System Ballast

Ballasts shall be UL listed, class P, thermally protected and fully compatible with the fixtures and digital dimming system to which they are connected. Ballast shall be independently addressable via digital code for programming zones, scenes and fades. Ballast shall be microprocessor controlled, with non-volatile memory for storing zones, scenes and fade times. Ballast control wiring shall be NEC class 1 or 2. Ballast THD at maximum light output shall be 10% with a maximum THD of 20% throughout its operating range. Lamp lighting level shall be constant regardless of line voltage fluctuations within 10% of nominal. Light level output shall be smooth, continuous and free of flicker over entire dimming range of 3-100%. Ballast inrush line current shall not exceed 3 amperes. Ballast shall be warranted by the manufacturer for 3 years.

2.12.6.2 Incandescent Dimmer Module

Incandescent dimmer modules shall be for operation at 120 volts and rated for the wattage of the connected incandescent fixture. Modules shall be independently addressable as with dimming ballast above and shall provide smooth, continuous flicker free dimming over the entire dimming range of 3-100%.

2.12.6.3 Infrared (IR) Ceiling Receiver

Receiver shall consist of power module and sensor and shall be compatible with hand held IR wireless control unit and wired digital control system. Sensor for the receiver shall be flush ceiling mounted. Module input voltage shall be compatible with the lighting system voltage in the area served.

2.12.6.4 Wall Control Stations

Wall control stations for conference rooms shall be single zone with pushbutton control for selecting scenes 1-4 for on/off, raise lower functions. Wall control stations for the auditorium shall have similar capabilities to the conference room units except shall have push-button access to 12 individual zones and programming for 12 individual zones scenes and fade times. Zone control pushbuttons shall be hidden by flip-up cover during normal operation.

2.12.6.5 Operation

Conference Rooms (106, 242, 266)

a. Each conference room will have a digital lighting dimming system. Control of the dimming system will be by a four-scene control station. This control station will provide a faceplate pushbutton access to four-scene selection, on/off, and up/down. This control station will support 277V operation and the control wiring for the electronic dimming ballasts. The control station will have an infrared receiver that will provide a wireless link between a handheld wireless IR remote control device and the digital lighting dimming system.
b. Each Conference room will have a flush mounted, ceiling infrared receiver. This receiver will provide a wireless link between a remote control and the digital dimming system in the room.
c. The handheld remote control device will have all functions and programmability of the four-scene control station.

Auditorium Room 104

a. The auditorium will have a digital lighting dimming system. Control of the auditorium dimming lights will be by a Scene/Zone Control Station. This control station will provide a faceplate pushbutton access to

four-scene selection, on/off, and up/down. This control station will support 277V operation and the control wiring for the electronic dimming ballasts. There will also be a flip cover to select 12 different zones, 12 different scenes with fade time and re-programming of the 12 different scenes, 12 different zones, and fade times. The control station will have an infrared receiver that will provide a wireless link between a remote control and the digital lighting dimming system.

b. Auditorium will have a flush mounted, ceiling infrared receiver. This receiver will provide a wireless link between a remote control and the digital dimming system in the room.
c. The remote control will have all functions and programmability of the Scene/Zone Control Station."

Section 16710A- Paragraph 2.2.1- In the fourth sentence, **change** "22 AWG" to "24 AWG".

Section 16710A- Add the following paragraph:

"2.4.3 Floor Mounted Cabinets

Equipment cabinets shall be floor-mounted enclosures with side panels, acrylic plastic front doors, rear louvered metal doors, depth-adjustable front and rear mounting rails, and louvered top. Ventilation fans will be included. Vertical cable management devices shall be integral to the cabinet. Power strips with 6 outlets shall be provided within the cabinet. Equipment racks shall be 30 inches deep. Cabinet exteriors shall be painted beige or ivory/off-white."

END

DEPARTMENT OF THE ARMY
UNITED STATES ARMY COMBINED ARMS SUPPORT COMMAND AND FORT LEE
3901 A AVENUE SUITE 200
FORT LEE, VIRGINIA 23801-1809

REPLY TO
ATTENTION OF

FORT LEE POLICY NO. 34-01

ATZM-EMO 4 September 2001

MEMORANDUM FOR FLOFMAIL/FLOTMAIL

SUBJECT: Minimizing the Introduction and Spread of Invasive Plant and Insect Species on Fort Lee, VA

1. **Purpose**. The purpose of this policy is to establish adequate procedures to reduce the potential introduction and spread of invasive species on Fort Lee, VA.

2. **References**.

   a. National Invasive Species Act of 1996 (P.L. 104 –332).

   b. Federal Noxious Weed Act of 1974 (with amendments).

   c. Executive Order 11987, Exotic Organisms, 24 May 77.

   d. Executive Order 11312, Invasive Species, 3 Feb 99.

   e. Invasive Alien Plant Species List of Virginia – Virginia Department of Conservation and Recreation.

3. Background. Invasive plants and insects are species that have been introduced into an environment where they did not evolve. As a result, these species usually have no natural enemies to limit their reproduction and spread. These species threaten biodiversity, threatened and endangered species, and the training mission - by rendering portions of training areas unusable. Invasive species have been introduced to Fort Lee by natural migration and through the transportation and planting of nursery stock. It is impossible to completely eradicate these species. It would be cost prohibitive to eliminate these species; however, steps can be taken to minimize the introduction and spread of invasive species.

4. Policy. Contracting agents will insert specifications into contracts requiring landscaping vendors to provide nursery stock that is nursery - certified to be free from insects, invasive plants, and their seeds. Contracting agents include all personnel

responsible for the procurement of landscaping goods and services who are responsible for the development of scopes of work, performance work statements, etc., or the direct purchase of landscaping materials (i.e., credit card purchases). A standard contract statement is inserted for inclusion in all procurement documents (including credit card and purchases). Copies of this certification must accompany shipping manifests of nursery stock and the agent will require copies per the contract prior to the commencement of planting. IMPAC cardholders purchasing landscaping services or nursery stock will also require a copy of the certification from the vendor prior to planting.

a. The Imported Red Fire Ant has been introduced into Virginia from nursery stock transported from Red Fire Ant quarantine states. The U. S. Department of Agriculture has signed compliance agreements with nurseries working in these states. Nursery stock or materials originating from the following states are required to have an Imported Red Fire Ant – free certificate attached to the shipping manifest: Georgia, Florida, North Carolina, Texas, Mississippi, Alabama, Louisiana, South Carolina, Tennessee, Arkansas, and Oklahoma. If the certificate is absent do not accept shipment of these materials.

b. Land management equipment operating in known areas of infestation will be thoroughly cleaned at a designated wash down site prior to relocating to uninfested areas. This requirement applies to equipment operated by DoD employees as well as contractors and vendors.

c. Whenever possible, native plant species grown from local stock should be used for conservation and landscaping purposes. There is an abundant variety of indigenous species available and they are usually less expensive.

d. DEL Natural Resources staff will regulate water levels in the Impact Area waterfowl impoundment at appropriate intervals to control the establishment of aquatic invasive species.

e. DEL Natural Resources staff will conduct an ongoing surveillance program to monitor the development of known infestations, control their spread, and be on the alert for new infestations. Funding permitting, the staff will reduce the invasive species population on Fort Lee.

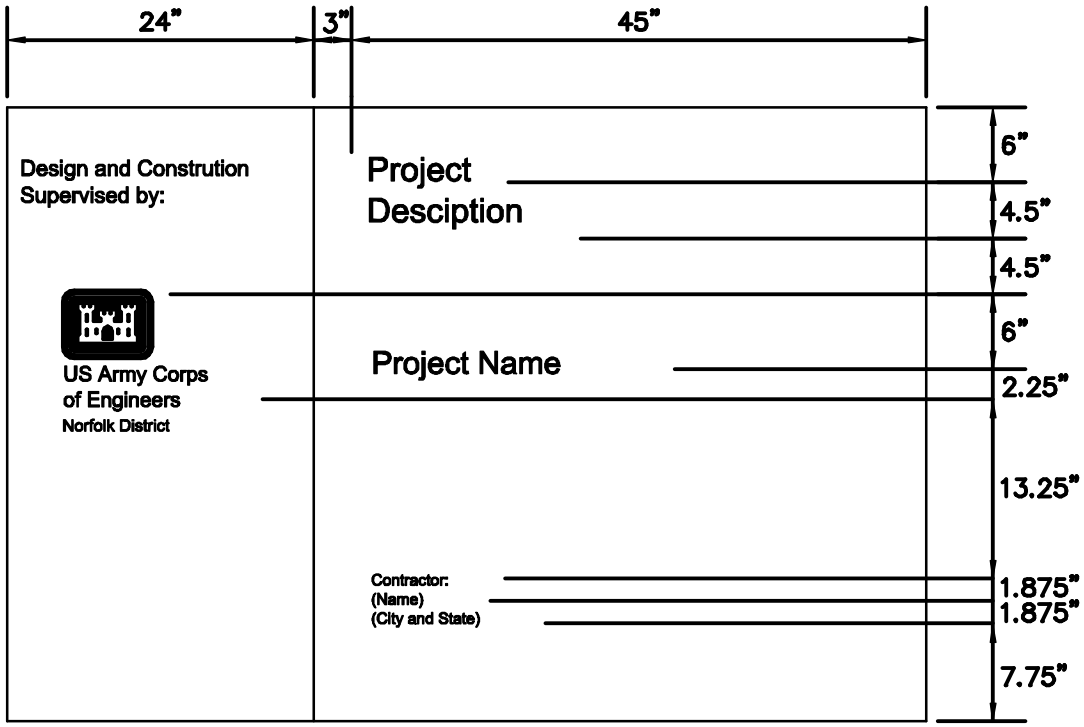
3. **Effective Date.** This policy is effective on the above-mentioned date of this memorandum.

4. **Proponent.** Proponent for this policy is DEL's Environmental Management Office, extension 45061.

Billy K. Solomon (signed)
BILLY K. SOLOMON
Lieutenant General, US Army
Commanding

PROJECT SIGN

The graphic format for this 4'x6' sign panel follows the legend guidelines and layout as specified below. The large 4'x4' section of the panel on the right is to white with black legend. The US Army Corps of Engineers graphic symbol shall be shown on the 24 inch wide left panel.



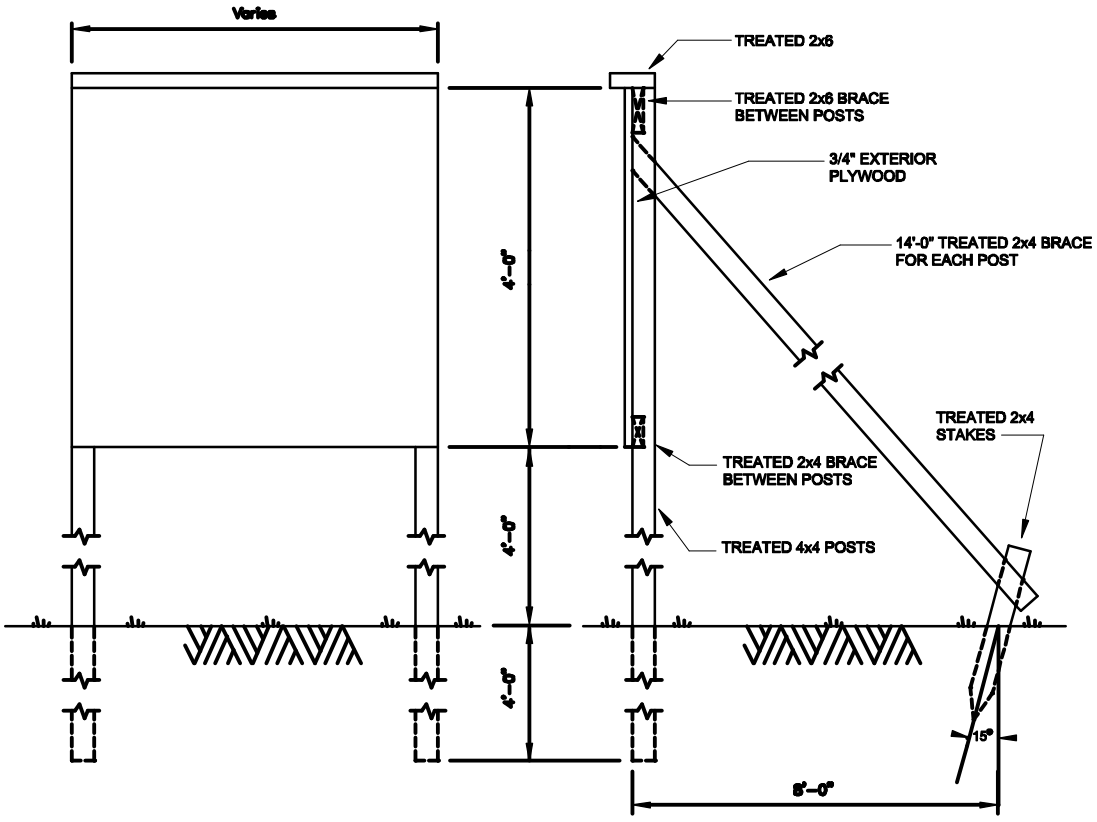
Project Description:
One to three line project title legend describes the work being done under this contract.
Color: Black; Typeface: 3" Helvetica Bold; Maximum line length: 42"

Project Name:
One to three line identification of project or facility.
Color: Black; Typeface 1.5" Helvetica Bold; Maximum line length: 42"
Cross-align the first line of PROJECT NAME with the first line of the Corps Signature as shown.

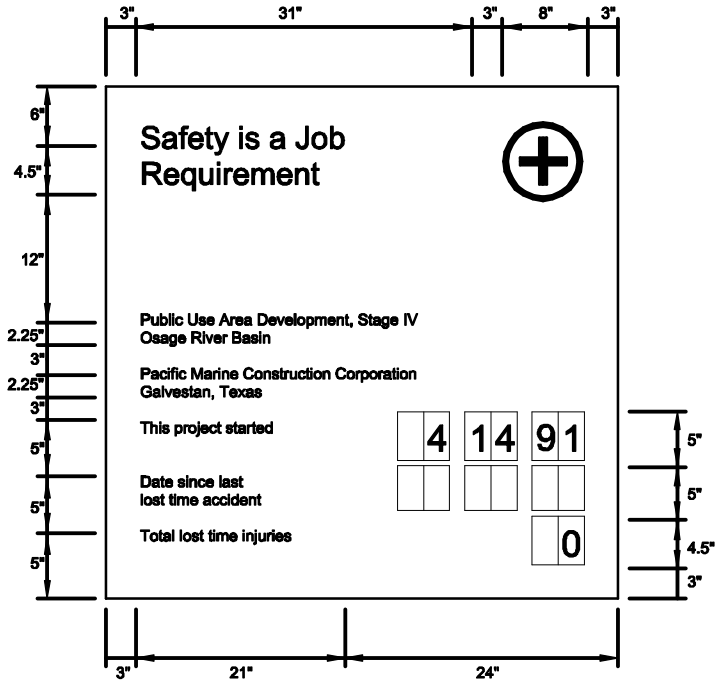
Contractor:
One to five line identification of prime contractors including: type(architect, general contractor, etc.), corporate or firm name, city, state.
Color: Black; Typeface: 1.25" Helvetica Bold; Maximum line length: 21"

All typography is flush left and ragged right, upper and lower case with initial capitals only as shown.
Letter and word spacing to follow Corps Standards (EP 310-1-6a and 6b).

SIGN ERECTION DETAILS



SAFETY SIGN



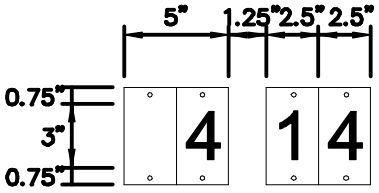
All typography is flush left and rag right, upper and lower case with initial capitals only as shown. Letter and word spacing to follow Corps Standards (EP 310-1-6a and 6b).

Legend Group 1: Standard two-line title "Safety is a Job Requirement" with (8" od.) Safety Green First Aid logo. Typeface: 3" Helvetiva Bold; Color: Black.

Legend Group 2: One to two-line project title legend describes the work being done under this contract and name of host project. Typeface: 1.5" Helvetica Regular; Color: Black; Maximum line length: 42".

Legend Group 3: One to two-line identification: name of prime contractor and city, state address. Typeface: 1.5" Helvetica Regular; Color: Black; Maximum line length: 42".

Legend Group 4: Standard safety record captions as shown. Typeface 1.25" Helvetica Regular; Color: Black.



Replaceable numbers are to be mounted on white 0.060 aluminum plates and screw-mounted to backdrop. Typeface: 3" Helvetica Regular; Color: Black; Plate size: 2.5"x 4.5".

SITE-SPECIFIC STORMWATER PACKAGE

This package contains the following:

- Site-Specific Stormwater Pollution Plan Requirements
- Construction Contractor Certification
- Information Checklist for SP3
- Blank Site-Specific SP3 for use as an example or template
- Construction Site Stormwater Inspection Form
- Copy Available from EMO

Provide to Fort Lee Environmental Management Office (EMO) prior to Construction
The plan must be approved by EMO:

- Site-specific Stormwater Pollution Prevention Plan
- Signed Construction Contractor Certification

Inspection forms must be maintained by contractor or project manager and copy provided to EMO Personnel.

EMO point of contact is Liz Scholl at 734-3560 or scholle@lee.army.mil

SITE-SPECIFIC STORMWATER POLLUTION PREVENTION PLAN REQUIREMENTS

Each construction activity at Fort Lee is required to have a site-specific Stormwater Pollution Plan (SP3). The SP3 will be generated by the construction contractor and submitted to the site's Construction/Project Manager and the EMO for review and approval. The initial site specific SP3 and all modifications including a signature page with the name of the person responsible for preparing the site-specific SP3 will be kept on file in EMO. The site-specific SP3 shall include the following information:

- Site Description
- Site Map
- Types of Controls
- Non-Stormwater Management
- Post-Construction Stormwater Management
- Waste Management and Disposal
- Maintenance, Inspection, and Repair Procedures
- Identification of Contractors, Subcontractors, and their tasks
- Monitoring and Reporting
- Certification

The key elements of the site-specific SP3 are the site description and the site map (Construction plan). The site map will include details of areas ¼ mile beyond the construction site boundaries and will provide the following information:

- Lateral limits of the construction site
- Surface water bodies, including known springs and wetlands
- Areas of soils to be disturbed
- Locations of controls to be used during construction
- Locations of stormwater management controls to be used post-construction
- Outline of off-site drainage areas that discharge into the construction site
- General topography
- Anticipated discharge location(s) where the construction site's stormwater discharges tot he installation's stormwater drainage system or other water body.

Descriptions of on-site sources shall be provided with the site-specific maps and shall outline proposed and proper on-site practices. Examples of these descriptions shall include the following:

- List of toxic materials that are known to have been treated, stored, disposed, spilled, or leaked in significant quantities (estimated volumes also to be listed) onto the construction site.
- Stormwater control practices for construction materials, equipment, and vehicles.
- Construction material loading, unloading, and access areas
- Equipment storage, cleaning, and maintenance areas.

A site-specific SP3 should not be limited to the above information. The requirements outlined above are the minimum requirements to satisfy Fort Lee's VPDES permit for stormwater discharges associated with construction activity; however, additional information not outlined above, but relevant to site-specific stormwater issues should be included with the site-specific SP3 for that construction site. References include EPA's Stormwater Management for Construction Activities – Developing Pollution Prevention Plans and Best Management Practices (EPA 833-R-92-001, October 1992), and Virginia's VR 680-14-19 VPDES General Permit Regulation for Stormwater Discharges from Construction Sites.

The Engineer responsible for reviewing the site-specific SP3 shall use the checklist provided to ensure that the necessary information is compiled for the plan. If additional information is required, the Engineer can request additional information from the Contractor or use the following supplemental sources:

- United States Geological Survey: For general topographic information and for locations of waterways receiving runoff from each project site.
- Natural Resources Conservation Service: For general soil information, including surface soil erosion potential.
- National Wetlands Inventory Maps: For general locations of documented sensitive wetland areas.
- Federal Emergency Management Agency: For floodplain map data indicating the extent of building restriction lines without flood protection.
- Previous in-house construction project data (if available): For geotechnical boring logs, slope stability studies for site grading, retaining walls, stream channel protection, storm or surface water sampling data, and aerial photography indicating locations of grasslands, woodlands, and unstable slopes.
- Virginia Sediment and Erosion Control Handbook

FORT LEE, VA
CONSTRUCTION CONTRACTOR CERTIFICATION

I certify, under penalty of law, that I have read and understand the terms and conditions of the general Virginia Pollutant Discharge elimination System (VPDES) permit that authorizes the stormwater discharges associated with the construction activity from the Fort Lee construction site and the Stormwater Pollution Prevention Plan (SP3) associated and identified as part of this certification.

Duty or Responsibility: _____

Contractor:

Name: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Phone: _____

Authorized Signature

Print Name: _____

Signature: _____

Title: _____

Date: _____

INFORMATION CHECKLIST FOR CONSTRUCTION SP3S

Site Description

- ☐ Description of project purpose
- ☐ Schedule of major soil disturbing activities
- ☐ Soil disturbances necessary to complete the project
  - ☐ Soil Excavation Grading Clearing
  - ☐ Soil Stockpiling Demolition Preparation for planting
  - ☐ Other(s) _____
- ☐ Estimate the size of the project site and the area to be disturbed
- ☐ Calculate the runoff coefficient for the site (before and after construction)
- ☐ Description of existing vegetation at the site
- ☐ Description of other potential pollution sources, including vehicle fueling, chemical storage, sanitary facilities, etc.
- ☐ Name of surface water body receiving runoff from the project site
- ☐ Pollution prevention site map
  - ☐ Drainage patterns and slopes/contours after grading
  - ☐ Areas of soil disturbance
  - ☐ Location of major structural and nonstructural controls identified under "Controls"
  - ☐ Location of areas requiring stabilization practices, including types of cover
  - ☐ Surface waters, including wetlands
  - ☐ Location of surface runoff discharge points and drainage areas
  - ☐ Existing and planned paved areas and buildings
  - ☐ Locations of permanent stormwater management practices
- ☐ Locations of other potential pollution sources

Controls

Description of applicable controls

- ☐ Erosion and Sediment Controls
  - ☐ Stabilization Practices
  - ☐ Structural Practices
- ☐ Stormwater Management
- ☐ Other Controls

Maintenance

- ☐ Description and schedule of maintenance procedures

Inspections

- ☐ At least once every 14 calendar days and within 48 hours of the end of a storm event that is 0.5 inches or greater. Where areas have been finally or temporarily stabilized or runoff is unlikely due to winter conditions (e.g., site is covered with snow, ice, or frozen ground exists) such inspections shall be conducted at least once every month.
- ☐ Inspection of disturbed areas, erosion and sediment control structures/practices, and exposed material storage areas
- ☐ Updates to SP3 based on inspections, if appropriate (within 7 days)
- ☐ Inspection reporting

Non Stormwater Discharges

- ☐ Identify all NSDs (except fire fighting flows)

Certifications

- ☐ Identify each measure and contractor/subcontractor responsible for implementation
- ☐ Certification statement signed by each identified contractor/subcontractor

SITE SPECIFIC STORMWATER POLLUTION PREVENTION PLAN

1.0 SITE DESCRIPTION

Project Name & Location:

Owner Name & Address: Commander, Fort Lee, VA
Directorate of Public Works
1816 Shop Road
Fort Lee VA 2380

Description of Purpose of Project:

Runoff Coefficient
Before construction: 0.30

After Construction: 0.73 (Rational Method)

Total Area of Construction Site: 9 Acres
Estimated Area of Soils to be disturbed: 12 Acres

Name(s) of Receiving Water(s):

2.0 SITE MAP

The following items are included on the site map (Appendix A). The list is presented in checklist form, with the plate number on which item can be found.

	Plate No.
☐ Drainage patterns and estimated slopes/contours after grading.	
☐ Areas of soil disturbance.	
☐ Locations of major structural and nonstructural controls.	
☐ Locations of areas requiring stabilization practices, including types of cover.	
☐ Surface waters, including wetlands.	
☐ Locations of surface runoff discharge points and associated drainage areas.	
☐ Existing and planned paved areas and buildings.	
☐ Locations of permanent stormwater management practices.	
☐ Locations of other potential pollution sources.	

3.0 POTENTIAL SOURCES

The following is a list of potential sources of stormwater pollution expected at Fort Lee construction sites. A check is placed next to all sources that apply to this particular construction site and activity. A blank has been provided at the end of the list for any additional potential sources.

Construction Activities

- ☒ Vegetation clearing
- ☒ Soil stockpiling
- ☐ Other: _____
- ☒ Excavations
- ☒ Grading

Other Sources

- ☐ Vehicle fueling
- ☐ Hazardous materials storage
- ☐ Solid waste storage
- ☐ Building materials (please specify):
- ☐ Other: _____
- ☐ Stockpiled gravel or asphalt
- ☐ Sanitary waste facilities

4.0 CONTROLS

The following is a che3cklist of control measures that are expected to be implemented during the course of this project. Other measures, not included on the list, are provided in the planks provided.

Erosion and Sediment Controls

Stabilization Practices

- ☒ Temporary Seeding
- ☒ Mulching
- ☐ Sod stabilization
- ☐ Protection of trees
- ☐ Other: _____
- ☐ Other: _____
- ☒ Permanent seeding
- ☐ Geotextiles
- ☐ Vegetative buffer strips
- ☐ Preservation of mature vegetation

Structural Controls

- ☐ Silt fencing
- ☒ Drainage swales
- ☐ Sediment basin(s)
- ☐ Subsurface drains
- ☐ Storm drain inlet protection
- ☐ Other: _____
- ☐ Earthen dikes
- ☐ Sediment traps
- ☐ Check dams
- ☒ Pipe slope drains
- ☐ Rock outlet protection

SITE SPECIFIC STORMWATER POLLUTION PREVENTION PLAN

Stormwater Management

The following measures will be installed during the construction process to control pollutants in stormwater discharges that may occur after construction is completed.

- [x] Stormwater detention ponds or other detention structures
- [ ] Stormwater retention ponds or other retention structures
- [x] Flow attenuation by use of open vegetated swales and natural depressions
- [ ] Infiltration of runoff on site
- [ ] Sequential systems (combination of several practices)
- [x] Velocity dissipation device at discharge locations to provide a non-erosive flow velocity
- [ ] Other: _____

Other Controls

Other types of controls not related to sediment and erosion control will be implemented during the course of the construction activity. All that apply are indicated.

Solid Wastes

- [ ] Place in closed dumpsters
- [ ] Place in trashcans with lids
- [ ] Other: _____

Hazardous Wastes

- [ ] Placed in closed, EPA/DOT- approved containers
- [ ] Stored in covered area (tarp, portable shed, lean-to)
- [ ] Placed within a bermed storage area
- [ ] Other: _____

Sanitary Waste

- [ ] Portable facilities that are closed and covered will be used
- [ ] Facilities in area where it is unlikely to be damaged or disturbed by heavy equipment.
- [ ] Other: _____

Raw Material Storage Areas

- [ ] Kept in closed, EPA/DOT – approved containers
- [ ] Stored in a covered material storage area (tarp, portable shed, lean-to)
- [ ] Kept within a bermed storage area
- [ ] Other: _____

5.0 TIMING OF ACTIVITIES AND CONTROLS

The following is a written description of soil-disturbing activities and controls, and in what sequence these activities will occur. Locations, areas(s) involved, and types of controls for each activity are described in the order they are expected to occur.

6.0 INSPECTIONS AND MAINTENANCE

Contractors will follow, at a minimum, the inspection and maintenance procedures outlined in Section 3.5 of Fort Lee's General SWP3 for Construction Activities. These procedures include inspections every 7 calendar days and within 24 hours of a 0.5-inch or more precipitation event. Any deviations from these procedures, including more stringent inspection and maintenance procedures, are provided below:

7.0 IDENTIFICIATIONOF NON-STORMWATER DISCHARGES

All non-stormwater discharges (NSDs) associated with construction activities that are planned or expected to occur during this construction activity are listed below:

- ☐ Discharges from fire fighting activities
- ☐ Fire hydrant flushing
- ☐ Water used to wash vehicles (no detergents) or control dust
- ☐ Air conditioning condensate
- ☐ Uncontaminated groundwater, including foundation or footing drains
- ☐ Pavement wash waters, where spills or leaks of toxic or hazardous materials have not occurred and where detergents are not used
- ☐ Potable water sources, including: water line flushing; irrigation drainage; lawn watering; and routine external building wash down that does not use detergents

8.0 MATERIAL INVENTORY

The following materials are expected to be on-site during the construction activities:

Construction materials

- ☐ Bags of cement and other dry materials
- ☐ Asphalt
- ☐ Tar
- ☐ Other: _____
- ☐ Drywall
- ☐ Metals

Hazardous materials

- ☐ Solvents
- ☐ Paints
- ☐ Pesticides/herbicides
- ☐ Other: _____
- ☐ Compressed gas cylinders
- ☐ Fertilizers
- ☐ Cleaners/detergents

Equipment maintenance materials

- ☐ Fuel
- ☐ Motor oil, grease
- ☐ Hydraulic fluids
- ☐ Other: _____
- ☐ Antifreeze
- ☐ Transmission fluid

Other materials not listed above

- ☐ Other: _____

9.0 GOOD HOUSEKEEPING

Contractors will follow, at a minimum, the good housekeeping procedures outlined in Section 3.2.3 of Fort Lee's General SWP3 for Construction Activities. Any expected deviations from these procedures are provided below:

10.0 SPILL PREVENTION

Contractors will follow, at a minimum, the spill prevention procedures outlined in Section 3.2.3 of Fort Lee's General SWP3 for Construction Activities. Any expected deviations form these procedures are provided below:

Are materials expected to be on-site that can spill or leak (e.g. fuel, oils, pints)?
☐ Yes ☐ No

Will a spill response kit be maintained on site?
☐ Yes ☐ No

11.0 CERTIFICATION

A signed copy of installation certification for this construction project is found in Appendix B.

12.0 CONTRACTOR'S CERTIFICATION

All contractors with responsibilities related to preventing stormwater pollution have signed certification forms provided in Appendix C.

Follow-up visit required
____ YES ____ NO

STORMWATER INSPECTION FORM FOR CONSTRUCTION PROJECTS
FORT LEE, VA

Inspect site at least once every 14 calendar days and within 48 hours of the end of a storm event that is 0.5 inches or greater.

Contract No./Plot (Area): _____ Date: _____
Site Description: _____

Weather Condition: _____
Days Since Last Rainfall: _____ Amount of Last Rainfall: _____
Project Manager: _____
On-site Construction Inspector: _____
Contractor: _____ Site Telephone #: _____
Contractor's Superintendent: _____ Contractor's Tel. #: _____
24 Hour Emergency Tel. #: _____ Stormwater Inspector: _____

Are the following practices in satisfactory condition
and in compliance with the Stormwater Pollution Prevention Plan?

EROSION & SEDIMENT CONTROL PRACTICES

___ surface roughening
___ silt fence
___ dust control
___ straw bale barrier
___ stormwater inlet protection
___ safety fencing
___ temporary stone construction entrance
___ ground cover/perm. or temp. seeding
___ geotextile fabric/visqueen
___ outlet protection
___ stockpile covers
___ other _____

Issues: _____
_____

Corrective Actions: _____
_____

GROUND MAINTENANCE PRACTICES

___ disposal of wash water to industrial waste system
___ presence of soil, grit or other sediment in sumps
___ other _____
___ wells in operation
___ holding tanks

Issues: _____
_____

Corrective Actions: _____
_____

Follow-up visit required
____ YES ____ NO

STORMWATER INSPECTION FORM FOR CONSTRUCTION PROJECTS
FORT LEE, VA

CONSTRUCTION MATERIAL STORAGE PRACTICES

___ general housekeeping
___ hazardous material – labels, storage practice
___ hazardous wastes – storage practices
___ spill response equipment
___ above ground storage tank (refueling)
___ paint
___ solvents
___ roof tar
___ storage shed(s)
___ construction material (type) _____
___other _____

Issues: _____
_____

Corrective Actions: _____
_____

CONSTRUCTION EQUIPMENT AND VEHICLE MANAGEMENT PRACTICES

___ equipment wash pad
___ equipment leaks
___ drip pans
___ equipment parts and hazardous wastes storage
___ equipment maintenance area
___ other _____
___ spill prevention
___ hazardous material storage tank
___ refueling area

Issues: _____
_____

Corrective Actions: _____
_____

Inspector:

Print Name: _____

Signature: _____

Representing: _____

SECTION 15995 (REV)

COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Clauses and Conditions
B. Related Sections:

1. Section 01330 - Submittal Procedures
2. Section 01320 - Project Schedule.
3. Section 01780 - Closeout Submittals.
4. Operation and Maintenance Data.
5. Division 15 –Mechanical
6. Division 16 – Electrical

1.2 SUMMARY

A. Commissioning procedures herein specified are intended to bring selected systems, subsystems, components, equipment and operating personnel to a state of operation in accordance with their design intent, for all modes of operation. To this end, this section includes design criteria and descriptions of each system's intended performance and operation.

B. This section defines and identifies the Commissioning Authority (CA) and the Commissioning Team (CT), establishes responsibilities of each participant and specifies required procedures, documentation and acceptance standards to be incorporated into a Commissioning Plan (CP) developed by the CA.

C. Pre-startup Checklists (PSC) and Performance Verification Forms (PVF) are included at the back of the section.

D. Training procedures, or Personnel Commissioning (PC) herein specified will involve instructions in system concepts, operating modes and equipment maintenance, as well as demonstrations by qualified product representatives, presented in terms of the design intent. Instructions will incorporate review of maintenance manuals, as-built documents, spare parts lists, balancing reports and other submittals required under other Divisions of this specification

E. Systems, subsystems and equipment addressed by the commissioning procedures include:
   I. Composite Chilled Water System (CWS).
   2. CWS Subsystems:
      a) Primary Chilled Water
      b) Secondary Chilled Water .
      c) Controls and Monitoring.
      d) Freeze Protection.
      e) Water Treatment.
      f) Refrigerant Leak Detection.
   3. CWS Components:
      a) Chillers, air cooled.
      b) Pumps.
      c) Piping.

d) Control Valves.
4. Composite Heating Water System (HWS).
5. HWS Subsystems:
   a) Combustion Air, Gas Train and Burners.
   b) Primary Heating Water Loop.
   c) Secondary Heating Water Distribution.
   d) Controls and Monitoring.
   e) Water Treatment.
6. HWS Components:
   a) Boilers.
   b) Pumps.
   c) Piping.
   d) Control Valves.
   e) Unit Heaters, Radiation and Terminal Coils
   f) Combustion Dampers
7. Composite Variable Air Volume (VAV) Air Handling Systems (AHS) - Typical of 5.
8. VAV AHS Subsystems:
   a) Air Handling Unit (AHU-1, 2, 3 4 and 5).
   b) interlocked Exhaust Fans (EF-I through EF-4 and EF-14)
   c) Air Distribution.
   d) Controls and Monitoring.
9. VAV AHU Components:
   a) Supply Fans.
   b) Return Fan.
   c) Exhaust Fan.
   d) Variable Frequency Drives.
   e) Filters.
   f) Dampers.
   g) Airflow Measuring Devices.
   h) Coils.
   i) VAV Terminal Units.
   j) Air Devices.
10. Composite Constant Volume Air Handling Systems (AHS) - Typical of 8.
11. Composite Building Automation System (BAS).
12. BAS Subsystems:
   a) Personal Computer13. BAS Components:
   b) System Architecture.
   c) Software Programs.
   d) Sequences of Operation.
   e) Graphics.
   f) Air Compressor.
   g) Sensors.
   h) Controllers.

1.3 REFERENCE

A. ASHRAE Guideline I-1996, "Guideline for Commissioning of HVAC Systems."

1.4 DEFINITIONS

A. Acceptable Performance: Satisfying and complying with requirements of the design criteria and design intent.

B. Design Criteria: The foundation for calculations, decisions, schemes, and product selections to achieve expected performance relating to the Government's requirements; and to satisfy applicable codes, standards, regulations, and guidelines.

C. Design Intent: A statement of what the selected systems must do, expectations of how they will be used and operated; and may include Government's requirements, project and design goals, and performance criteria.

D. Commissioning: The process for achieving, verifying, and documenting the performance of systems, subsystems, and equipment to meet the design intent within the context of the Contract Documents and for preparing the Government's personnel for maintenance and operations.

E. Commissioning Authority: An agent identified by the Government, who will plan, schedule, and supervise the commissioning processes.

F. Commissioning Agent: An authorized representative of the Commissioning Authority.

G. Commissioning Team: Those who shall participate in the commissioning process under the direction of the Commissioning Authority.

H. Commissioning Plan: A list of construction phase events that outlines the organization, scheduling, allocation of resources, and documentation pertaining to commissioning.

I. Performance Verification Testing: Process for verifying ability of a system, subsystem, or equipment to achieve the design intent.

J. Personnel Commissioning: Training of Government's operations and maintenance personnel in the selected system's concepts, operating modes and equipment maintenance, as well as demonstrations by qualified product representatives, presented in terms of the design intent.

I.5 QUALITY ASSURANCE

A. Test Equipment Calibration Requirements: Comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damage. Affix calibration tags to test instruments.

1.6 COMMISSIONING AUTHORITY (CA)

A. The Government shall be the CA and shall plan, schedule and direct the commissioning process.

B. The CA Director shall be a registered professional engineer, with full understanding of the design intent, systems descriptions, operating modes and the commissioning process. The CA and the CA Director, shall be referred to interchangeably in this specification as the CA.

1.6.1 COMMISSIONING TEAM (CT)

A. In addition to the CA, the CT shall be comprised of the following:

Designation	Function
I	General Contractor's representative.
Q	Contractor's technical supervisor
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
T	Contractor's Testing, Adjusting, & Balancing Representative
C	Contractor's Controls Representative
D	Design Agent's Representative
O	Contracting Officer's Representative

U Using Agency's Representative

Equipment and product representatives where specified and where required by the CA.

B. The CA, prior to the commencement of Commissioning procedures shall approve all members of the CT. All approved representatives shall remain on the CT throughout the commissioning process, to its successful completion. Substitutions will not be permitted, unless submitted to and approved in writing by the CA. The General Contractor shall submit for approval a list of all contractor and subcontractor representatives responsible for the completion of the commissioning process and all manufacturer representatives as called fore in individual Division 2, 13, 15 and 16 specification sections. The Government, through the Contracting Officer, shall submit a list of CT representatives, to include all Government representatives, maintenance and operations personnel to receive instruction and witness demonstrations and all Government furnished contractor representatives (Security, Communications and Audio Visual). The completed and approved CT list shall be distributed to all CT representatives.

1.7 CT QUALIFICATIONS

A. General Contractor Representative: The General Contractor representative must have full authority of the General Contractor. At the Contractor's discretion, his representative may be the technical supervisor as qualified below.

B. Technical Supervisor: The Contractor shall select a technical supervisor who is capable of operating all types of equipment installed on the project and associated with systems to be Commissioned. The supervisor must be capable of coordinating with all building trades. He must have a minimum of five years experience in the installation of central heating and cooling plants, ductwork, HVAC units, switchgear, power wiring and controls, in addition to air and water balancing and systems startup. He must have full understanding of the design intent, systems descriptions, operating modes and the commissioning process. If meeting these qualifications, the general contractor representative may also serve as the technical supervisor. As part of the CT members list submittal, the Contractor shall indicate technical supervisor qualification compliance.

C. Contracting Officer Representatives: The Contracting Officer's representative must have full authority of the Contracting Officer. The Contracting Officer shall be responsible for requiring that the Government's operating and maintenance personnel are familiar with the system descriptions, operating sequences and design intent included in this specification.

D. Subcontractor Representatives: (Mechanical, Electrical, and TABS) Subcontractor representatives must have full authority of their respective subcontractor. Each representative must be familiar with the design intent, systems descriptions, operating modes and the commissioning process. Each representative must have full knowledge of all aspects of systems and equipment installations, pertinent to the Subcontractors trade, or a minimum of five years experience in the supervision of similar installations. As part of the CT members list submittal, the Contractor shall indicate Subcontractor qualification compliance.

E. Manufacturer Representatives: Manufacturer representatives shall be registered engineers or technical personnel with manufacturer's authorization and certification in their complete technical and operational knowledge of their product. Sales personnel without the prescribed qualifications are not acceptable. Each representative must be familiar with the design intent, systems descriptions and operating modes pertinent to his product and it's associated system or subsystem, as well as, all aspects of the actual product submitted and installed. The Contractor's CT submittal shall include written confirmation of compliance, from each manufacturer, for their respective representative's qualifications.

1.8 CA RESPONSIBILITIES

A. The CA shall be responsible for insuring that all aspects of the commissioning process are

accomplished in adherence with the design intent.

B. The CA shall develop a Commission Plan (CP) for the implementation of commissioning procedures.

C. The CA shall develop and deliver a CP schedule to the Contractor within 20 calendar days after the Notice to Proceed is acknowledged. The CA shall meet with Contractor to coordinate with his Project Schedule development.

D. The CA shall review and approve qualifications of the CT and direct them in the implementation the CP. The CA shall provide a list of approved CT personnel to all CT representatives. The CA shall direct demonstrations and personnel training to insure there presentation in terms of the design intent.

E. The CA shall conduct commissioning coordination meetings, and Performance Verification Conferences.

F. The CA shall maintain commissioning reports, performance verification reports and meeting minutes in a Commissioning Binder. The CA shall distribute copies of commissioning reports, performance verification reports and meeting minutes to the CT.

G. The CA shall witness all quality control testing, manufacturer's inspections and manufacturers/contractor startups.

H. The CA will conduct the CT in all performance verification testing.

I. The CA shall receive all commissioning correspondence. Review and approval of all commissioning submittals, quality control reports and startup checklists, PVFs, as-built documentation and O & M manuals shall be by the CA.

J The CA shall make final recommendations for Government acceptance of performance verification.

K. The CA shall be responsible for maintaining and updating commissioning documentation until final acceptance of the commissioning process. Documentation binder(s) shall be kept current by the CA and shall be available for inspection on request.

1.9 CONTRACTOR RESPONSIBILITIES

A. The Contractor shall provide all commissioning submittals required of him by this specification. The Contractor shall insure the availability of as-built documents, O & M manuals, spare parts lists, balance reports and other submittals to the Government, required under Divisions I , I 5 and 16. The Contractor shall update these submittals with any revisions resultant of the commissioning process.

B. The Contractor shall provide coordination and cooperation of all trades in preparing for and implementing the CP. The Contractor shall coordinate the commissioning schedule with any off hour procedures necessitated by Government activities. Division of work among appropriate subcontractor and trade shall be the responsibility of the Contractor. The Contractor shall schedule and assemble all approved contractor and manufacturer CT representatives required by this specification, or requested by the CA for each Commissioning procedure.

C. The Contractor shall provide all utilities and instrumentation necessary to carry out

commissioning procedures specified herein, including such expendable items as water, fuels, chemicals and other materials. The Contractor shall provide any tools, equipment and devices required for access.

D. The Contractor shall complete pre-startup checklists and perform any remedial work necessary for preparation of Performance Verification Tests (PVT). The Contractor shall document all remedial action taken.

E. The Contractor shall perform PVT, complete PVFs, provide corrective measures and retest as required to achieve PVT acceptance. The Contractor shall provide coordination and cooperation of all subcontractors, trades and manufacturers representatives, in implementation of PVT, performance of corrective measures and retests.

F. The Contractor shall establish and maintain quality control as required by provisions of the Contract Documents, including specified documentation of same.

1.10 GOVERNMENT RESPONSIBILITIES

A. The Government shall coordinate and cooperate in the scheduling of commissioning procedures, area access and systems outages. The CO shall coordinate participation of Government CT representatives, including operating and maintenance personnel and Audio Visual Contractor's representatives.

B. The CO shall be responsible for requiring operating and maintenance personnel to become familiar with the system descriptions, operating sequences, and design intent included in this specification.

1.11 COORDINATION

A. The CA shall coordinate commissioning meetings and conferences with the Contractor and CO .

B. Project Schedule, CP Schedule Coordination Meeting: The Contractor and CA shall meet in accordance with Section 01320 - "Project Schedule" to coordinate the integration of the CP schedule into the Project Schedule.

C. Pre-Commissioning Conference: Conduct a meeting with the CT chaired by the CA, prior to the beginning of any commissioning procedures. Include a commissioning plan review with discussions of the commissioning schedules, processes, and assignment of responsibilities.

D. Commissioning Coordination Meetings: Conduct weekly coordination meetings with the CT chaired by the CA, to review progress on the commissioning plan, work out scheduling conflicts, and to discuss strategies and processes for upcoming commissioning tasks.

E. Field Quality Control Testing and Manufacturer's Inspection and Startup Services: The Contractor shall coordinate field quality control testing and services of manufacturer's inspection and startup services specified in other sections. The Contractor shall complete PSCs prior to startup. The CA shall coordinate with the Contractor and his scheduling of testing personnel and manufacturer's representatives, for the CA, CO and Government operating personnel to witness testing and startup procedures.

F. PVT Conference: Conduct a meeting with the CT chaired by the CA, on completion of PSCs and startup procedures and prior to the beginning of any PVT. Review startup reports, remedial action reports, completed PSCs, PVT schedule, PVT procedures and PVFs, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, and equipment to be commissioned.

G. PVT Coordination Meetings: Conduct daily coordination meetings with the CT chaired by the CA, to review progress on PVT procedures, work out scheduling conflicts, and to discuss strategies and processes for upcoming PVTs and remedial action.

1.12 SUBMITTALS

A. CA submittals to the Government:
   I . Commissioning Plan: Submit a detailed CP integrated with the Project Schedule specified in Section 01320.
   2. Operator Training Program: Submit a schedule and outlines for CP, identifying subject agenda, times, dates, locations, required CT participation, trainers, trainers' qualifications, training-aids, and services of manufacturer's service representatives.
   3. Commissioning Documentation: Submit CT list, approved commissioning submittals, commissioning conference and meeting minutes, commissioning reports and remedial action reports.
   4. Functional Performance Test Reports: Submit daily reports for each PVT.
   5. Final Acceptance Recommendations: Submit final acceptance recommendations for each PVT.
   6. Commissioning Binders: Submit original and two copies of finalized commissioning binders.

B. Minimum Contractor submittals to the CA (additional submittals may be requested by the CA):
   I. Submit CT Members List and Qualifications as herein specified.
   2. Submit Manufacturers Representatives List and Qualifications as herein specified.
   4. Submit completed PSCs as herein specified.
   6. Submit detailed remedial action reports. Initial submittal shall be a description of any remedial action and causes for the action, resultant of commissioning procedures (pre-startup, startup and/or PVT) and shall be submitted to the CA at the end of the day on which the commissioning procedure was performed. Follow-up remedial action progress reports shall be submitted every third day thereafter, until unsatisfactory condition is corrected and the commissioning procedure can be repeated. Each report shall include:
      a) Date, CT attendees, commissioning procedure and effected system, subsystem and equipment
      b) Items discussed and summary of proceedings
      c) Deficiencies noted
      d) Remedial action taken
      e) Those performing remedial action
      f) Estimated time for completion
      g) Current progress, problems, delays, action(s) taken to resolve and revised schedule for completion
      h) Notice of resolution and readiness to repeat commissioning procedure
   7. Submit complete, up to date record drawings, as built documents and O & M manuals, in accordance with Sections 01780 - "Closeout Submittals." 01781 "Operation and Maintenance Data" and 01330 "Submittal Procedures and this section.

C. Minimum Government submittals to the CA (additional submittals may be requested by the CA):
   I . Submit CO, Government and Audio Visual Contractors CT Members List and

Qualifications as herein specified.

1.13 PRE-STARTUP CHECKLISTS (PSC) AND STARTUP PROCEDURES

A. PSC and startup procedures shall be performed in accordance with Division 15 and 16 Sections pertinent to the system, subsystem and/or equipment being started.

B. All PSCs shall be completed and submitted to the CA prior to the PVT Conference. PSCs shall be initialed by all CT participants indicated and shall denote remedial action(s), associated reports and startup procedures have been successfully completed.

1.14 PERFORMANCE VERIFICATION FORMS (PVF) AND PERFORMANCE VERIFICATION TEST (PVT) PROCEDURES

A PVTs shall be executed subsequent to and in accordance with the PVT Conference.

B. PVF and PVT procedures shall be performed in accordance with this section and PVFs and PVT procedures developed by the Security, Communications and Audio Visual Contractors that have been approved by the CA.

C. All systems, subsystems and related equipment will be evaluated based on sequences of operation, system descriptions, scheduled equipment capacities and approved shop drawings.

D. The CA shall direct the CT in the successful completion of PVFs and PVT procedures.

E. PVT shall be aborted if the successful completion of the test is prevented by:
I . Any deficiency subsequent to startups that prevents beginning the PVT.
2. Any non-Government CT or Manufacturer's representative (of which participation is specified or required by the CA) is not present for the test.
3. Unacceptable delays in the completion of remedial actions.
4. Any deficiency subsequent to PVT remedial actions.
The Contractor shall reimburse the Government for all costs associated with effort lost due to PVT that are aborted. These costs shall include salary, travel and per diem costs for Government and CA and design professional CT members.

F. The CA shall maintain and submit daily commissioning reports, for all PVT procedures. The Contractor shall report on and direct subcontractors in the successful completion of remedial action(s).

G. Remedial action will commence immediately and, unless satisfactorily reported otherwise, be completed within three days of initial PVT. When remedial action has been successfully completed, PVT shall again be executed, starting with the failed component and continuing through the complete related system.

H. The Contractor shall update record drawings, as built documents and O & M manuals with any revision resulting from PVT and any remedial action(s).

I. When all PVFs has been successfully completed and commissioning documentation has been submitted to the CO, the CA shall recommend Government acceptance of each system.

1.15 COMMISSIONING BINDERS

A. All CA, Contractor and Government commissioning submittals shall be included in a commissioning documentation binder. At the time of final acceptance of the commissioning process, the CA shall furnish the original and two copies of updated commissioning

documentation binders to the Government. This documentation shall be organized by system and sub-system and include sections for PSCs, PVTs, remedial action reports, daily commissioning reports, acceptance recommendations, commissioning submittals and record of instructions (PC). Sections shall be tabbed and a table of contents page shall be provided in each binder. Binders shall be labeled, "Commissioning Binder, Book I," with succeeding books noted 11,111, IV, and so on.

1.16 PERSONNEL COMMISSIONING (PC), INSTRUCTIONS TO GOVERNMENT OPERATING AND MAINTENANCE PERSONNEL

A. Prior to Substantial Completion and after PVT acceptance, fully instruct Government operation and maintenance personnel in operation, adjustment, and maintenance of products, equipment and systems requiring regular maintenance. Perform instructions within continuous period of 30 days. For equipment that requires seasonal operation, provide similar instruction during other seasons.
   I. Include demonstrations by qualified manufacturer's representatives as required in pertinent Division 15

B. Employ record drawings, as built documents and O & M manuals, updated and submitted in accordance with this section 01780, as basis of instruction. Review contents of O & M manuals with personnel in full detail, explaining all aspects of operations and maintenance. Include detailed review of following items:
   I. Design Intent.
   2. Sequences of Operation.
   3. O & M manuals.
   2. Record documents.
   3. Balancing Reports.
   4. Approved Shop Drawings.
   5. Spare parts and materials.

C. Submit record of instructions as part of Commissioning Binder. For each instructional period, record of instructions shall include:
   I. Date
   2. System or equipment involved
   3. Names of participants, identifying instructors, Manufacturer's representatives and Government personnel.
   4. Demonstrations performed.
   5. Handouts and instructional materials.

PART 2 - DESIGN INTENT

2.1 GENERAL DESIGN CRITERIA

A. Outdoor Summer Dry Bulb (DB): 92.0 degrees F

B. Outdoor Summer Wet Bulb (WB): 76.0 degrees F

C. Outdoor Winter DB: 17.0 degrees F

D. Indoor Conditions:
   I. Occupied Cooling: 75.0 degrees F, 50% RH
   2. Unoccupied Cooling: 85.0 degrees F
   3. Occupied Heating: 68.0 degrees F
   4. Unoccupied Heating. 60.0 degrees F

E. Ventilation: 20 cfm (9.44 lps) per occupant per ASHRAE Standard 62, "Ventilation for

Acceptable Indoor Air Quality."

F. Humidity: Actively controlled (to humidify and dehumidify) in computer spaces and select technical labs only.

G. Building Envelope:

I . Wall Insulation:	R25
2. Wall U-value:	.033 BTU/hr/sgft/F
3. Roof Insulation:	R24
4. Roof U-value:	.032 BTU/hr/sgft/F
5.Window U-value:	0.280 BTU/hr/sgft/F
6.Window Shade Coefficient:	0.430

H. Sound Criteria: Noise levels due to HVAC equipment and ductwork attain sound pressure levels in all 8-octave bands in occupied spaces conforming to NC-40except as below:

I. Private Offices conform to NC - 35.
2. Lobbies, Toilets, Corridors, Computer Terminal Rooms, Laboratories (without exhaust hoods) and Spaces within 10 feet (3 meters) of duct penetrations through shafts and/or the roof conform to NC-45
3. Storage, Locker Rooms, Fitness Center, Kitchen, Dining and Computer Rooms conform to NC-50
4. Printing Shop and Rooms with exhaust hoods conform to NC - 60.
5. Motor drives for pumps and chillers operate with noise levels not exceeding 90 dB(A) determined in accordance with IEEE Standard #85 Test "Procedure for Airborne Noise Measurements on Rotating Electric Equipment."
6. Boiler sound pressure levels when operated under installed conditions shall be 90 dB(A) when measured in accordance with ARI Standard 575-73

PART 3 - EXECUTION

3.1 CT CHECKLISTS

A. Each PSC and PVF included in this Section's Appendices A and B shall be completed by the CT. Acceptance by each CT participant of each PSC line item shall be indicated by their respective initials and date unless an "X" indicates participation by that CT member is not required. Acceptance by each CT participant of each PVF shall be indicated by their respective signature and date.

B. PSC and PVT procedures required by this section shall be performed in a manner, which essentially duplicates checking, quality control tests and inspections and Manufacture's assisted startups established in pertinent Sections of Divisions 15 and 16. Requirements in related Sections are independent from those of this section and shall not be used to satisfy requirements of this section .

C. CT member participation in PSC procedures shall be as follows:

Designation	Function
Q	Contractor's Technical Supervisor
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
T	Contractor's Testing Adjusting and Balancing Representative
C	Contractor's Controls Representative
D	Design Agent's Representative
O	Contracting Officer's Representative
U	Using Agency Representatives

P Product Manufacturer's Representative

3.2 PSCs

A. PSCs shall be completed prior to the PVT Conference and commencement of PVT procedures. PSCs will not be accepted as complete until all items have been initialed and dated signifying any remedial work has been successfully completed and systems or equipment is ready for PVT.

B. Pre-startup commissioning checks shall be performed for the items indicated on the PSCs in this Section's Appendix A. Deficiencies discovered during these checks shall be corrected, the Contractor shall submit remedial action reports and retests shall be conducted in accordance with this section .

3.3 PVTs

A. PVTs shall be performed for the items indicated on the PVFs in Section's Appendix B. PVT shall begin only after PSCs have been successfully completed and shall be in accordance with this section, the CP and the PVT Conference.

B. PVT Objectives and Scope: Verify and demonstrate the ability of systems, subsystems, and equipment to perform according to the design intent. PVT shall prove all modes of the sequences of operation and shall verify all other relevant contract requirements:
   I . Operate each system, subsystem, and equipment through all modes of operations and part, full load and seasonal conditions where there is a specified system response.
   2. Verify each sequence of operation.
   3. Verify proper responses and planned modes and conditions, including normal and abnormal operating conditions and emergency operating conditions.

C. PVTs shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any PVF item, the Contractor shall correct all deficiencies, submit remedial action reports and retests shall be conducted until there are no errors in accordance with this section.

D. PVT Methods: Verify and test performance by manipulating equipment and observing performance and responses or where specified by monitoring the performance and analyzing the results using BAS monitoring and trend log capabilities or by portable data loggers.
   I . Verify and test performance using actual conditions whenever possible.
   2. Simulate conditions (i.e., as impose an artificial load) as closely as possible to actual and anticipated conditions. Before simulating conditions, calibrate sensors, transducers, and devices. Set and document simulated conditions and methods of simulation. After test, return settings to normal operating conditions.
   3. Alter setpoints when simulating conditions is not practical.
   4. Overwrite sensor values with a signal generator when actual or simulate conditions and altering set points are not practical. Do not use sensor to act as the signal generator to simulate conditions or overwrite values.
   5. Use indirect indicators for responses or performance only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings, through the control system, represent actual conditions and responses.
   6. Multiple, identical pieces of non-life-safety and non-critical equipment may be tested using sample testing strategies. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates there common identity. A small size or capacity difference, alone, does not constitute a difference. Include and identify sampling strategies and rates in commissioning plan

submittal for approval.

E. VAV Terminal PVT: VAV terminal PVTs shall be performed by manipulating actual room conditions or sensor set points and observing performance and responses for a minimum of 25% of the terminal units (randomly selected by the CA). Depending upon the success rate of the directly observed VAV terminal PVTs, the CA may direct that remaining tests be conducted by monitoring performance and analyzing results using BAS monitoring and trend log capabilities.

3.4 ACCEPTANCE

A. Upon failure to complete a PVF, the CA's daily commissioning report shall include the Contractor's remedial action report, listing deficiencies causing failure and remedies to correct all deficiencies. Subsequent daily commissioning reports shall include the Contractor's subsequent remedial action reports, noting status and progress of all corrective measures underway at that time. Corrections shall be accomplished concurrent with ongoing PVTs of other non-related systems.

B. When all deficiencies have been corrected, the entire PVF for that item of equipment, or subsystem shall be repeated. No system will be accepted until all equipment or sub-system items have complete PVFs, thereby demonstrating satisfactory performance.

C. Failure to complete two successive PVFs for the same equipment or sub-system constitutes failure of the PVT for that item of equipment, or subsystem. In the event of a failure, the PVT shall be aborted in accordance with Paragraph I .15, E of this section .

D. Successfully completed PV checklists shall be submitted to the CA for review. The CA shall recommend in writing acceptance of the system by the Government.

END OF SECTION

Attachment Appendix A, Pre-Startup Checklists (PSC)
Appendix B, Performance Verification Forms (PVF)

PSC - Piping

For CWS - Chilled Water Piping System:

Checklist Item	G	M	E	T	B	D	O	U
Installation								
a. Piping complete.	__	__	X	__	X	__	__	__
b. As-built shop drawings up to date.	__	__	X	__	X	__	__	__
c. Piping flushed and cleaned.	__	__	X	__	X	__	__	__
d. Strainers cleaned.	__	__	X	__	X	__	__	__
e. Valves installed as required.	__	__	X	__	X	__	__	__
f. Piping insulated as required.	__	__	X	__	X	__	__	__
g.Thermometers and gauges installed as required.	__	__	X	__	X	__	__	__
h. Verify operation of valves.	__	__	X	X	__	__	__	__
i. Air separator, expansion tank, makeup water connection installed as specified.	__	__	X	X	X	__	__	__
j. Flexible connectors installed as specified.	__	__	X	X	X	__	__	__
k. Verify that piping has been labeled and valves identified as specified.	__	X	__	__	__	__	__	__
l. Testing, Adjusting, and Balancing (TAB)								
a. Hydrostatic test complete.	__	__	X	__	X	__	__	__
b. TAB operation complete.	__	__	X	__	__	__	__	__

PSC - Pumps

For CWS - Primary Chilled Water Pump:

Checklist Item	G	M	E	T	B	D	O	U
Installation								
a. Pumps grouted in place.	__	__	X	X	X	__	__	__
b. Pump vibration isolation devices functional.	__	__	X	X	X	__	__	__
c. Pump/motor coupling alignment verified.	__	__	X	X	X	__	__	__
d. Piping system installed.	__	__	X	X	X	__	__	__
e. Piping system pressure tested.	__	__	X	X	X	__	__	__
f. Pump not leaking.	__	__	X	X	X	__	__	__
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	__	__	X	X	X	__	__	__
Electrical								
a. Power available to pump disconnect.	__	__	__	X	X	__	__	__
b. Pump rotation verified.	__	__	__	X	X	__	__	__
c. Control system interlocks functional.	__	__	__	X	__	__	__	__
d. Verify that power disconnect is located within sight of the unit it controls.	__	__	__	X	__	__	__	__
Testing, Adjusting, and Balancing (TAB)								
a. Pressure/temperature gauges installed.	__	__	X	__	X	__	__	__
b. Piping system cleaned.	__	__	X	X	X	__	__	__
c. Water balance complete.	__	__	X	__	X	__	__	__
d. Water balance with design maximum flow.	__	__	X	__	X	__	__	__
e. TAB Report submitted.	__	__	X	__	X	__	__	__

For CWS - Chiller #1 Pump:

Checklist Item	G M E T B D O U P
Installation	
a. Pumps grouted in place.	__ __ X X X __ __ __ X
b. Pump vibration isolation devices functional.	__ __ X X X __ __ __ X
c. Pump/motor coupling alignment verified.	__ __ X X X __ __ __ X
d. Piping system installed.	__ __ X X X __ __ __ X
e. Piping system pressure tested.	__ __ X X X __ __ __ X
f. Pump not leaking.	__ __ X X X __ __ __ X
g. Pump VFD installed as specked.	__ __X X X __ __ __ __
h. Field assembled couplings aligned to meet manufacturer's prescribed tolerance.	__ __ X X X __ __ __ X
Electrical	
Power available to pump disconnect.	__ __ X X X __ __ __ X
b. b. Power available to pump VFD.	__ __X X X __ __ __ __
c. Pump rotation verified.	__ __ X X X __ __ __ X
d. Control system interlocks functional.	__ __X X X __ __ __ __
e. Pump speed control operational according to specifications.	__ __ __ __ __ __ __ __ __
f. Verify that power disconnect is located within sight of the unit it controls.	__ __ __ X __ __ __ __ X

PSC - Pumps (Continued)

For CWS - Chilled #1 Pump:

Checklist Item	G	M	E	T	C	D	O	U	P
Testing, Adjusting, and Balancing (TAB)									
a. Pressure/temperature gauges installed.	__	__	X	__	X	__	__	__	X
b. b. Piping system cleaned.	__	__	X	X	X	__	__	__	X
c. c. Water balance complete.	__	__	X	__	X	__	__	__	X
d. d. Water balance with design maximum flow.	__	__	X	__	X	__	__	__	X
e. TAB Report submitted.	__	__	X	__	X	__	__	__	X

PSC - Pumps

For CWS - Chiller #2 Pump:

Checklist Item	G	M	E	T	B	D	O	U	P
Installation									
a. Pumps grouted in place.	__	__	X	X	X	__	__	__	X
b. Pump vibration isolation devices functional.	__	__	X	X	X	__	__	__	X
c. Pump/motor coupling alignment verified.	__	__	X	X	X	__	__	__	X
d. Piping system installed.	__	__	X	X	X	__	__	__	X
e. Piping system pressure tested.	__	__	X	X	X	__	__	__	X
f. Pump not leaking.	__	__	X	X	X	__	__	__	X
g. Pump VFD installed as specked.	__	__	X	X	X	__	__	__	__
h. Field assembled couplings aligned to meet manufacturer's prescribed tolerance.	__	__	X	X	X	__	__	__	X
Electrical									
a. Power available to pump disconnect.	__	__	X	X	X	__	__	__	X
b. Power available to pump VFD.	__	__	X	X	X	__	__	__	__
c. Pump rotation verified.	__	__	X	X	X	__	__	__	X
d. Control system interlocks functional.	__	__	X	X	X	__	__	__	__
e. Pump speed control operational according to specifications.	__	__	__	__	__	__	__	__	__
f. Verify that power disconnect is located within sight of the unit it controls.	__	__	__	X	__	__	__	__	X

PSC - Pumps (Continued)

For CWS - Chilled #2 Pump:

Checklist Item	G	M	E	T	C	D	O	U	P
Testing, Adjusting, and Balancing (TAB)									
a. Pressure/temperature gauges installed.	__	__	X	__	X	__	__	__	X
b. Piping system cleaned.	__	__	X	X	X	__	__	__	X
c. Water balance complete.	__	__	X	__	X	__	__	__	X
d. Water balance with design maximum flow.	__	__	X	__	X	__	__	__	X
e. TAB Report submitted.	__	__	X	__	X	__	__	__	X

PSC – Air Cooled Chiller

For CWS Chiller:

Checklist Item	G	M	E	T	B	D	O	U	P
Installation									
a. Chilled water connections properly piped.	__	__	X	__	__	__	__	__	X
b. Chilled water pipe leak tested.	__	__	X	__	__	__	__	__	X
c. Manufacturer's required maintenance clearance provided.	__	__	X	XX	__	__	__	__	__
Electrical									
a. Power available to unit starter.	__	__	__	X	__	__	__	__	X
b. Power available to VFD (CH- I and CH-2).	__	__	__	X	__	__	__	__	X
c. Power available to unit control panel.	__	__	__	X	__	__	__	__	X
d. Verify that power disconnect is located within sight of the unit it controls.	__	__	__	X	__	__	__	__	X
Controls									
a. Factory startup and checkout complete.	__	__	X	X	__	__	__	__	X
b. Chilled Control Center and BAS interface tested.	__	__	X	X	__	__	__	__	X

PSC – Air Cooled Chiller (Continued)

For CWS Chiller:

Checklist Item	G	M	E	T	B	D	O	U	P
a. Chiller safety/protection devices tested.				X					
b. Chilled VFD and capacity control tested.				X					
c. Chilled water flow switch installed.			X	X					
d. Chilled water flow switch tested.			X	X					
e. Chilled water pump interlock installed.				X					
f. Chilled water pump interlock tested.				X					

PSC – Piping

For HWS Piping System

Checklist Item	G	M	E	T	B	D	O	U
Installation								
a. Piping complete.	__	__	X	__	X	__	__	__
b. As-built shop drawings up to date.	__	__	X	__	X	__	__	__
c. Piping flushed and cleaned.	__	__	X	__	X	__	__	__
d. Strainers cleaned.	__	__	X	__	X	__	__	__
e. Valves installed as required.	__	__	X	__	X	__	__	__
f. Piping insulated as required.	__	__	X	__	X	__	__	__
g. Thermometers and gauges installed as required.	__	__	X	__	X	__	__	__
h. Verify operation of valves.	__	__	X	__	__	__	__	__
i. Air vents, air separator, expansion tank, and makeup water connection installed as specified.	__	__	X	X	X	__	__	__
j. Flexible connectors installed as specified.	__	__	X	X	X	__	__	__
k. Verify that piping has been labeled and valves identified as specified.	__	__	X	__	__	__	__	__
Testing, Adjusting, and Balancing (TAB)								
a. Hydrostatic test complete.	__	__	X	__	X	__	__	__
b. TAB operation complete.	__	__	X	__	__	__	__	__

PSC – Pumps

For HWS - Primary Pump:

Checklist Item	G	M	E	T	B	D	O	U
Installation								
a. Pumps grouted in place.	__	__	X	X	X	__	__	__
b. Pump vibration isolation devices functional.	__	__	X	X	X	__	__	__
c. Pump/motor coupling alignment verified.	__	__	X	X	X	__	__	__
d. Piping system installed.	__	__	X	X	X	__	__	__
e. Piping system pressure tested.	__	__	X	X	X	__	__	__
f. Pump not leaking.	__	__	X	X	X	__	__	__
Electrical								
a. Owner available to pump disconnect.	__	__	X	X	__	__	__	__
b. Pump rotation verified.	__	__	X	X	__	__	__	__
c. Control system interlocks functional.	__	__	__	X	__	__	__	__
d. Verify that power disconnect is located within sight of the unit it controls.	__	__	__	X	__	__	__	__
Testing, Adjusting, and Balancing (TAB)								
a. Pressure/temperature gauges installed.	__	__	X	__	X	__	__	__
b. Piping system cleaned.	__	__	X	X	X	__	__	__
c. Chemical water treatment complete.	__	__	X	X	X	__	__	__
d. Water balance complete.	__	__	X	__	X	__	__	__
e. Water balance with design maximum flow.	__	__	X	__	X	__	__	__
f. TAB Report submitted.	__	__	X	__	X	__	__	__

PSC - Pumps

For HWS Secondary Pump:

Checklist Item	G	M	E	T	B	D	O	U	P
Installation									
a. Pumps grouted in place.	__	__	X	X	X	__	__	__	X
b. Pump vibration isolation devices functional.	__	__	X	X	X	__	__	__	X
c. Pump/motor coupling alignment verified.	__	__	X	X	X	__	__	__	X
d. Piping system installed.	__	__	X	X	X	__	__	__	X
e. Piping system pressure tested.	__	__	X	X	X	__	__	__	X
f. Pump not leaking.	__	__	X	X	X	__	__	__	X
Electrical									
a. Power available to pump disconnect.	__	__	__	X	X	__	__	__	X
b. Pump rotation verified.	__	__	__	X	X	__	__	__	X
c. Control system interlocks functional.	__	__	__	X	__	__	__	__	__
d. Verify that power disconnect is located within sight of the unit it controls.	__	__	__	X	__	__	__	__	X
Testing, Adjusting, and Balancing (TAB)									
a. Pressure/temperature gauges installed.	__	__	X	__	X	__	__	__	X
b. Piping system cleaned.	__	__	X	X	X	__	__	__	X

PSC - Pumps (Continued)

For HWS Secondary Pump: P-2

Checklist Item	G	M	E	T	B	D	O	U	P
a. Water balance complete.	__	__	X	__	X	__	__	__	X
b.Water balance with design maximum flow.	__	__	X	__	X	__	__	__	X
c. TAB Report submitted.	__	__	X	__	X	__	__	__	X

PSC – Glycol Make Up System

GMUS -1:

Checklist Item	G	M	E	T	B	D	O	U	P
Installation									
a. Solution	__	__	X	__	__	__	__	__	X
b.Solution	__	__	X	X	__	__	__	__	X
c.Manufacturer's required maintenance clearance provided.	__	__	X	__	__	__	__	__	__
Startup									
a. Solution Tank cleaned and filled with 30% Propylene Glycol Solution.	__	__	X	__	__	__	__	__	X
b. System Pressure Controls and Alarms, have been tested.	__	__	__	X	__	__	__	__	__
c. System startup and checkout complete.	__	__	X	X	__	__	__	__	__
Electrical									
a. Verify that power disconnect is located within sight of the unit served.	__	__	__	X	__	__	__	__	__

APPENDIX B

Performance Verification Forms (PVF)

PSC - Heater (Unit, Cabinet Unit and Baseboard)

For HWS Heater:

Checklist Item	G	M	E	T	B	D	O	U
Installation								
a. Hot water piping properly connected.	__	__	X	__	__	__	__	__
b. Hot water piping pressure tested.	__	__	X	__	__	__	__	__
c. Air vent installed on hot water coil with shutoff valve as specified.	__	__	X	X	X	__	__	__
d. Any damage to coil fins has been repaired.	__	__	X	__	X	__	__	__
e. Manufacturer's required maintenance/ operational clearance provided.	__	__	X	X	X	__	__	__
Electrical (Unit and Cabinet Unit)								
a. Power available to unit disconnect.	__	__	__	X	__	__	__	__
b. Proper motor rotation verified.	__	__	__	X	X	__	__	__
c. Verify that power disconnect is located within sight of the unit it controls.	__	__	__	X	__	__	__	__
d. Power available to electric heating coil.								
Controls	__	__	__	X	__	__	__	__
a. Control valves properly installed.	__	__	__	X	__	__	__	__
b. Control valves operable.	__	__	X	X	__	__	__	__
c. Verify proper location and installation of thermostat.	__	__	__	X	__	__	__	__
d. On/off/auto switch operable.	__	__	__	X	X	__	__	__
Testing, Adjusting, and Balancing (TAB)								
a. TAB Report submitted.	__	__	X	__	X	__	__	__

PSC - Ductwork

For AHS Air Handler:

Checklist Item	G	M	E	T	B	D	O	U
Installation								
a. Ductwork complete.	__	__	X	__	X	__	__	__
b. As-built shop drawings submitted.	__	__	X	__	X	__	__	__
c. Ductwork leak test complete.	__	__	X	__	X	__	__	__
d. Fire dampers, smoke dampers, and access doors installed as required.	__	__	X	__	X	__	__	__
e. Ductwork insulated as required.	__	__	X	__	X	__	__	__
f. Thermometers and gauges installed as required.	__	__	__	__	__	__	__	__
g. Verify open/closed status of dampers.	__	__	X	__	X	__	__	__
h. Verify smoke dampers operation.	__	__	X	__	__	__	__	__
i. Flexible connectors installed as specified.	__	__	X	__	X	__	__	__
Testing, Adjusting, and Balancing (TAB)								
a. TAB operation complete.	__	__	X	__	X	__	__	__

PSC - Variable Volume Air Handling Unit (AHU-l, 2, 3, 4, and 5)

For Air Handling Unit:

Checklist Item	G M E T B D O U P
Installation	
a. Internal vibration isolation devices installed.	__ __ X X X __ __ __ __
a. Inspection and access doors are operable and sealed.	__ __ X __ X __ __ __ X
c. Exterior casing undamaged.	__ __ X X X __ __ __ X
d. Interior walls floor and roof undamaged.	__ __ X X X __ __ __ X
e. Condensate drainage is unobstructed. (Visually verify drainage by pouring a cup of water into drain pan(s).)	__ __ X X X __ __ __ X
f. Verify unit has been cleared.	__ __ X X X __ __ __ X
g. Verify simulated filter loading	__ __ __ X __ __ __ __ __
Electrical	
a. Power available to unit power panel.	__ __ __ X X __ __ __ X
b. Power available to unit lighting junction box.	__ __ __ X __ __ __ __ X
c. All factory wiring verified.	__ __ __ X __ __ __ __ X
d. All lights are operable and replaced with new bulbs.	__ __ __ X X __ __ __ X
e. All power outlets operable.	__ __ __ X X __ __ __ X
f. Proper motor rotation verified.	
g. Verify that power disconnect is located within sight of the fans it controls.	__ __ __ X __ __ __ __ __
h. Electric heating unit heaters operable.	__ __ __ X X __ __ __ X
Coils	
a. Chilled water piping properly installed and connected.	__ __ X X X __ __ __ X
b. Chilled water piping pressure tested.	__ __ X X X __ __ __ __

PSC - Variable Volume Air Handling Unit (AHU-I, 2, 3, and 4) (Continued)

For Air Handling Unit:

Checklist Item	G	M	E	T	B	D	O	U	P
c. Hot water piping properly installed and connected.	__	__	X	X	X	__	__	__	__
d. Hot water piping pressure tested.	__	__	X	X	X	__	__	__	__
e. Air vents installed on water coils as specified.	__	__	X	X	X	__	__	__	__
f. Any damage to coil fins has been repaired.	__	__	X	__	X	__	__	__	__
Controls									
a. Control valves/actuators properly installed.	__	__	X	__	__	__	__	__	X
b. Control valves/actuators operable.	__	__	X	__	__	__	__	__	X
c. Dampers/actuators properly installed.	__	__	X	__	__	__	__	__	X
d. Dampers/actuators operable.	__	__	X	__	__	__	__	__	X
e. Verify supply and return fan VFDs are installed, calibrated and operable.	__	__	__	__	__	__	__	__	__
f. Verify air measuring devices for supply fan, supply fan, return fan and outdoor air are installed, calibrated and operable.	__	__	X	__	__	__	__	__	__
g. Verify proper location, installation and calibration of duct static pressure sensor.	__	__	X	__	__	__	__	__	X
h. Verify proper location, installation and calibration of all unit mounted temperature, pressure, and smoke sensors and freezstat.	__	__	X	__	__	__	__	__	X
i. Supply fan VFD and air volume control operable.	__	__	X	__	__	__	__	__	__
j. Air handier controls system operational.	__	__	X	__	__	__	__	__	X
k. Verify fire alarm interface operational.	__	__	__	__	__	__	__	__	X

PSC -Variable Volume Air Handling Unit (AHU-I, 2, 3, and 4) (Continued)

For Air Handling Unit:

Checklist Item	G	M	E	T	B	D	O	U	P
Testing, Adjusting, and Balancing (TAB)									
a. Construction filters removed and replaced.	__	__	X	__	__	__	__	__	X
b. TAB report submitted.	__	__	X	__	X	__	__	__	X
c. TAB results within +10%/-0% of Us shown on drawings.	__	__	X	__	X	__	__	__	X
d. TAB results for outside air intake within +10%/-0% of both the minimum and maximum Us cfms shown on drawings.									
e. TAB results for supply/return fan tracking within +10%/-0%								__	__ X
f. TAB results for minimum outdoor air damper operation within +10%/-0%.	__	__	X	__	__	__	__	__	X

PSC - VAV Terminal, Fan Powered

For VAV Terminal:

Checklist Item	G	M	E	T	B	D	O	U
Installation								
a. VAV terminal in place.	__	__	X	X	X	__	__	__
b. VAV terminal ducted.	__	__	X	X	X	__	__	__
c. VAV terminal connected to controls.	__	__	X	X	__	__	__	__
d. Reheat coil connected to hot water pipe.	__	__	X	__	X	__	__	__
e. Proper maintenance clearance provided.	__	__	X	X	X	__	__	__
Electrical								
a. Power provided to terminal.	__	__	__	X	X	__	__	__
b. Disconnect operational.	__	__	__	X	X	__	__	__
c. Terminal fan operational	__	__	__	X	X	__	__	__
Controls								
a. Cooling only VAV terminal controls set.	__	__	X	X	__	__	__	__
b. Cooling only VAV controls verified.	__	__	X	X	__	__	__	__
c. Reheat VAV terminal controls set.	__	__	X	X	__	__	__	__
d. Reheat terminal/coil controls verified.	__	__	X	X	__	__	__	__
e. Verify unoccupied override switch operable.	__	__	X	X	__	__	__	__
Testing, Adjusting, and Balancing (TAB)								
a. Verify terminal primary maximum air flow set.	__	__	X	__	__	__	__	__
b. Verify terminal primary minimum airflow set.	__	__	X	__	__	__	__	__

PSC - VAV Terminal (Continued)

For VAV Terminal:

Check list Item	G	M	E	T	B	D	O	U
c. Verify plenum air flow damper operational and calibrated.	__	__	X	__	X	__	__	__
d. Verify factory set fan I /S is correct.	__	__	X	__	X	__	__	__
e. TAB operation complete.	__	__	X	__	X	__	__	__

PSC - VAV Terminal, Shut Off Type

For VAV Terminal:

Checklist Item	G	M	E	T	B	D	O	U
Installation								
a. VAV terminal in place.	__	__	X	X	X	__	__	__
b. VAV terminal ducted.	__	__	X	X	X	__	__	__
c. VAV terminal connected to controls.	__	__	X	X	__	__	__	__
d. Reheat coil connected to hot water pipe.	__	__	X	__	X	__	__	__
e. Proper maintenance clearance provided.	__	__	X	X	X	__	__	__
Electrical								
a. Power provided to terminal.	__	__	__	X	X	__	__	__
b. Disconnect operational.	__	__	__	X	X	__	__	__
c. Terminal fan operational	__	__	__	X	X	__	__	__
Controls								
a. Cooling only VAV terminal controls set.	__	__	X	X	__	__	__	__
b. Cooling only VAV controls verified.	__	__	X	X	__	__	__	__
c. Reheat VAV terminal controls set.	__	__	X	X	__	__	__	__
d. Reheat terminal/coil controls verified.	__	__	X	X	__	__	__	__
e. Verify unoccupied override switch operable.	__	__	X	X	__	__	__	__
Testing, Adjusting, and Balancing (TAB)								
a. Verify terminal primary maximum air flow set.	__	__	X	__	__	__	__	__
b. Verify terminal primary minimum airflow set.	__	__	X	__	__	__	__	__

PSC –Fans, Exhaust and Supply

For Fan:

Checklist Item	G	M	E	T	B	D	O	U
Installation								
a. Fan belt adjusted	__	X	__	X	__	__	__	__
Electrical								
a. Power available to fan disconnect	__	__	__	X	__	__	__	__
b. Proper motor rotation verified	__	__	__	__	X	__	__	__
c. Verify that power disconnect is located within Sight of the unit it controls	__	__	__	X	__	__	__	__
Controls								
a. Control interlocks properly installed.	__	__	__	X	__	__	__	__
b. Control interlocks operable	__	__	__	X	__	__	__	__
c. Dampers/actuators properly installed	__	__	X	X	__	__	__	__
d. Dampers/actuators operable	__	__	X	__	__	__	__	__
e. Verify proper location and installation of thermostat.	__	__	X	__	__	__	__	__
f. Verify control interface with burners (SF-1).	__	__	X	__	__	__	__	__
Testing, Adjusting, and Balancing (TAB)								
a. TAB results +10%/-0% to L/s shown on drawings	__	__	X	__	X	__	__	__
b. TAB Report submitted	__	__	X	__	X	__	__	__

PSC –Heating and Ventilating Unit

For HV-1:

Checklist Item	G M E T B D O U
Installation	
a.Vibration isolation devices installed.	__ __ X X X __ __ __
b. Inspection and access doors are operable and sealed.	__ __ X __ X __ __ __
c. Casing undamaged.	__ __ X X X __ __ __ __
d. Insulation undamaged	__ __ __ X __ __ __ __
e. Fan belt(s) adjusted.	__ __ X __ X __ __ __
f. Gas piping installed	
g. Gas piping tested	
h. Manufacturer's required maintenance clearance provided	__ __ X X X __ __ __
i. Verify unit has been cleaned	__ __ __ __ __ __ __ __
j. Verify simulated filter loading.	__ __ __ __ __ __ __ __
Electrical	
a. Power available to unit disconnect.	__ __ __ X X __ __ __
b. Power available to unit control panel	__ __ __ X __ __ __ __
c. Proper motor rotation verified	__ __ __ __ X __ __ __
Controls	
a. Control properly installed	__ __ X __ __ __ __ __
b. Control operable.	__ __ X __ __ __ __ __
c. Dampers/actuators properly installed	__ __ X __ __ __ __ __
d. Dampers/actuators operable	__ __ X __ __ __ __ __
e. Verify proper location and installation of thermostat or duct temperature sensor	__ __ X __ __ __ __ __
f. Verify fire alarm interface operational	__ __ __ __ __ __ __ __
Testing, Adjusting, and Balancing (TAB)	
a. Construction filters removed and replaced.	__ __ X __ X __ __ __

(Continued)
PSC –Heating and Ventilating Unit

For HV-1:

b. TAB results +10%/-0% L/s shown on drawings	__	__	X	__	X	__	__	__
c. TAB Report submitted.	__	__	X	__	X	__	__	__

PVF – Pumps

For Pump:
Prior to performing the PVT, make sure the water system is pressurized and the make-up water system is operational or for open loop systems, that the sumps are filled to the proper level.

1. Activate pump start using control system commands (all possible combination, on/auto, etc.).
ON_____ AUTO_____ OFF_____

a. Verify pressure drop across strainer

Strainer inlet pressure _____ psig
Strainer outlet pressure _____ psig

b. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) report pump design conditions, and pump manufacturer's performance.

	DESIGN	TAB	ACTUAL
Pump inlet pressure (psig)	_____	_____	_____
Pump outlet pressure (psig)	_____	_____	_____

c. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices

	SHUTOFF	100 percent
Pump inlet pressure (psig)	_____	_____
Pump Outlet Pressure	_____	_____
Pump flow rate (gpm)	_____	_____

d. Operation pump at shutoff and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	SHUTOFF	100 percent
Pump inlet pressure (psig)	_____	_____
Pump Outlet Pressure	_____	_____
Pump flow rate (gpm)	_____	_____

2. Verify motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions.

a. Full flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

PVF-Pumps (Continued)

For Pump _____:

b. Minimum flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

3. Unusual vibration, noise, etc.

---

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

	Signature and Date
Commissioning Authority	_____
Contractor's Technical Supervisor	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Representative	_____
Contractor's Controls Representative	_____
Contracting Officer's Representative	_____
Using Agency's Representative	_____
Design Professional's Representative	_____

PVF – Air Cooled Chiller

For Chiller _____:

1. PVT: Contractor shall demonstrate operation of CWS as per specifications including all modes of operation and the following: Start building air handler to provide load for chiller. Activate controls system chiller start sequence as follows:

    a. BAS startup command initiates chiller start: _____

    b. Start chilled water pump and established chiller water flow. Verify chiller chilled water proof- of-flow switch operation. _____

    c. Verify control system energizes chiller start sequence. _____

    d. Verify chiller senses chilled water temperature above set point and control system activates chiller start _____

    e. Verify failure of valves/chillers and back-up sequences._____

    f. Shut off air handling equipment to remove load on chilled water system. Verify chiller shutdown sequence is initiated and accomplished after load is removed. _____

    g. Restart air handling equipment one minute after chiller shut down. Verify condenser water pump, cooling tower, and chiller restart sequence. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Commissioning Authority _____

Contractor's Technical Supervisor _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Design Professional's Representative _____

PVF – Hot Water Boiler

For Boiler _____

1. PVT: Contractor shall demonstrate operation of HWS as per specifications including the following: Start building heating equipment to provide load for boiler. Activate controls system boiler start sequence as follows.

a. Start hot water pump and establish hot water flow. Verify boiler hot water proof-of-flow switch operation. _____

b. Verify control system energizes boiler start sequence. _____

c. Verify boiler senses hot water temperature below set point and control system activates boiler start. _____

d. Shut off building heating equipment to remove load on hot water system. Verify boiler shutdown sequence is initiated and accomplished after load is removed. _____

e. Verify valve/boiler failure back-up sequences._____

2. Verify boiler inlet/outlet pressure reading, compare to Test and Balance (TAB) Report, boiler design conditions, and boiler manufacturer's performance data.

	DESIGN	TAB	ACTUAL
Boiler inlet pressure (psig)	_____	_____	_____
Boiler outlet pressure (psig)	_____	_____	_____
Boiler flow rate (gpm)	_____	_____	_____
Flue-gas temperature at boiler outlet	_____	_____	_____
Percent carbon dioxide in flue-gas	_____	_____	_____
Draft at boiler flue gas exit	_____	_____	_____
Draft or pressure in furnace	_____	_____	_____
Stack emission pollutants concentration	_____	_____	_____
Fuel type	_____	_____	_____
Combustion efficiency	_____	_____	_____

3. Record the following information

Ambient temperature	_____degrees F
Entering hot water temperature	_____degrees F
Leaving hot water temperature	_____degrees F

4. Verify temperatures in item 3 are in accordance with the reset schedule.

_____

5. Verify proper operation of boiler safeties _____

6. Unusual vibration, noise, etc.

_____

_____

7. Visually check refractory for cracks or spalling and refractory and tubes for flame impigement

_____

PVF – Hot Water Boiler (continued)

For Boiler _____

8. Certification: We the undersigned have witnessed the above functional performances tests and certification

	Signature and Date
Commissioning Authority	_____
Contractor's Technical Supervisor	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Representative	_____
Contractor's Controls Representative	_____
Contracting Officer's Representative	_____
Using Agency's Representative	_____
Design Professional's Representative	_____

PVF – Heaters

1. PVF: Contractor shall demonstrate operation of heaters as per the following:

   a. Verify heater response to room temperature set point adjustment. Change heating set point to heating set point minus 10 degrees and return to heating set point. _____

   b. Check blower fan speed _____rpm

   c. Check heating mode outlet air temperature. Check heating mode outlet air temperature. _____ degrees F

2. Certification: We the undersigned have witnessed the above functional performances tests and certification

	Signature and Date
Commissioning Authority	_____
Contractor's Technical Supervisor	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Representative	_____
Contractor's Controls Representative	_____
Contracting Officer's Representative	_____
Using Agency's Representative	_____
Design Professional's Representative	_____

PVF – Variable Volume Air Handling Unit

For Air Handling Unit _____:

Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate minimum OA, economizer RA, EA and smoke dampers from fully open to fully closed positions.

1. PVT: Contractor shall verify operation of air handling unit as per specification including the following:

   a. The following shall be verified when the pre-occupied mode is initiated:

      (1) All dampers in normal position. _____

      (2) All valves in normal position._____

      (3) System safeties allow start if safety conditions are met._____

      (4) Fan VFD shall "soft-start" fans._____

   b. Occupied mode of operation – economizer de-energized

      (1) Minimum outside air damper open._____

      (2) Return air damper open._____

      (3) Relief air damper at minimum position._____

      (4) Economizer damper closed. _____

      (5) Chilled water control valve modulating to maintain leaving air temperature set point.

      _____

      (6) Supply fan VFD receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure set point
      _____

      (7) Modulate all VAV terminals to minimum primary air flow and verify that the static pressure does not exceed the design static pressure Class shown._____

      (8) Supply and return fan air measuring devices are controlling return fan to maintain specified supply/return airflow differentials. _____

      (9) Modulate all VAV terminals to minimum primary air flow and verify minimum outdoor air measuring device modulates RA and EA dampers to maintain minimum outdoor air setpoints._____

   c. Occupied mode of operation – economizer energized.

      (1) economizer damper modulated to maintain mixed air temperature set point.
      _____

      (2) EA and RA dampers modulate with economizer damper according to sequence of operation.
      _____

      (3) Chilled water control valve modulating to maintain leaving air temperature set point.
      _____

PVF – Variable Volume Air Handling Unit (Continued)

(4) Hot water control valve modulating to maintain leaving air temperature set point. _____

(5) Supply fan VFD receiving signal from duct static pressure sensor and modulating fan to maintain supply duct static pressure set point. _____

d. Unoccupied mode of operation

(1) All dampers in unoccupied position._____

(2) All valves in unoccupied position. _____

(3) Fans de-energize. _____

(4) Low temperature operation of unit heaters and control valves. _____

e. Verify the chilled water coil control valve operation by setting all VAV's to maximum and minimum cooling.

	Max cooling	Min cooling
Supply air volume _____cfm	_____	_____
Supply air temp. _____degrees F	_____	_____

f. Verify safety shut down initiated by smoke detectors_____

g. Verify safety shut down initiated by low temperature protection thermostat. _____

h. Verify filter loading pressure differential alarms._____

2. Certification: We the undersigned have witnessed the above functional performances tests and certification

Signature and Date

Commissioning Authority _____

Contractor's Technical Supervisor _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Design Professional's Representative _____

PVF – VAV Terminals

The CA will select VAV terminals to be spot-checked during the PVT. The number of terminals shall not exceed 30 percent

1. PVT: Contractor shall demonstrate operation of selected VAV boxes as per specifications including the following:

a. Cooling only VAV boxes

(1) Verify VAV box response to room temperature set point adjustment. Turn thermostat to 5 degrees F above ambient and measure maximum air flow. Turn thermostat to 5 degrees F below ambient and measure minimum air flow.

Maximum flow _____cfm
Minimum flow _____cfm

(2) Check damper maximum/minimum flow settings

Maximum flow _____cfm
Minimum flow _____cfm

b. Fan powered VAV boxes:

(1) Verify VAV box response to sensor call for heating via set point adjustment. Changes to be cooling set point to heating set point and return to cooling set point _____. Verify cooling damper closes to minimum position, blower fan energizes according to sequence of operation, and upon further drop in space temperature, heating coil activation and de-activation. _____

(2) Check primary air damper maximum/minimum flow settings.

Maximum flow _____cfm
Minimum flow _____cfm

(3) Check blower fan flow _____cfm

(4) Verify free operation of fan backdraft damper (insure no primary air is being discharged through the re-circulated air register). _____

(5) Verify that no re-circulated air is being induced when box is in full cooling._____

2. Certification: We the undersigned have witnessed the above functional performances tests and certification.

Signature and Date

Commissioning Authority _____

Contractor's Technical Supervisor _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

PVF – VAV Terminals (continued)

Contracting Officer's Representative _____

Using Agency's Representative _____

Design Professional's Representative _____

PVF – Single Zone Air Handling Unit

For HV Unit: _____

1. PVT: Contractor shall verify operation of air handling unit as per specification including the following:

   a. The following shall be verified when the pre-occupied mode in initiated:

      (1) All dampers in normal position._____

      (2) All valves in normal position._____

      (3) System safeties allow start if safety conditions are met._____

   b. Occupied mode of operation

      (1) Outside air damper at maximum position _____

      (2) Gas control valve modulating to maintain heating temperature set point. _____

      (3) Supply air flow measuring device controls fan operation as specified. _____

      (4) Fan speed. _____

   c. The following shall be verified when the supply fan off and return fan (where indicated) off mode is initiated:

      (1) All dampers in normal position._____

      (2) All valves in normal position. _____

      (3) Fan de-energizes. _____

   d. Verify safety shut down initiated by smoke detectors. _____

   e. Verify filter loading pressure differential alarms. _____

2. Certification: We the undersigned have witnessed the above functional performances tests and certification.

Signature and Date

Commissioning Authority _____

Contractor's Technical Supervisor _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

PVF – Single Zone Air Handling Unit

For HV Unit: _____

Design Professional's Representative _____

PVF – Fans, Exhaust and Supply

For Fan _____

Prior to performing the PVT make sure power is available to the fan and that the DSC has bewen performed.

(1) Activate fan start by using appropriate control

(1) On-Off switch_____

(2) Interlock with HV unit _____

(3) Thermostat _____

(4) Timer (EMCS)_____

(5) Speed Control _____

a. Verify fan operation upon appropriate control command.

b. Verify gravity shutter operation _____

c. Verify motor operated shutter operation _____

d. Verify thermostat controlling at set point _____

e. Record voltage and amperage for single phase motors.

Amperage_____

Volts _____

f. Record motor amperage, each phase, and voltage, phase to phase and phase to ground for 3 phase motors

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

2. Note any control or equipment malfunction, unusual noise or vibration.

_____

_____

_____

3. Certification: We the undersigned have witnessed the above functional performances tests and certification.

Signature and Date

Commissioning Authority _____

Contractor's Technical Supervisor _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

PVF – Fans, Exhaust and Supply

For Fan _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Design Professional's Representative _____

PVF – Automatic Glycol make up system

Prior to performing the PVT, make sure the chilled water system is filled (and vented) To proper pressure. The make up solution tank is filled and electric power is functional at the pump.

1. Lower pressure in chilled water system by draining system until system pressure drops below minimum desired pressure of 12 psig (save drained solution to pour back into make up unit solution tank).

   a. Verify that make up system is actuated and pumps solution into the system until a system pressure of 20 psig is reached at which point the make up system pump will shut down.

   b. Remove Glycol solution from make up unit solution tank until solution level drops to low level alarm point. Verify audible and visual alarm operation

   c. Record voltage and amperage of single phase motor

      Voltage _____

      Amperage _____

2. Note any control or equipment malfunction.

3. Certification: We the undersigned have witnessed the above functional performances tests and certification.

	Signature and Date
Commissioning Authority	_____
Contractor's Technical Supervisor	_____
Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Representative	_____
Contractor's Controls Representative	_____
Contracting Officer's Representative	_____
Using Agency's Representative	_____
Design Professional's Representative	_____

PVF – HVAC Controls
For HVAC System _____:

1. PVT": Contractor shall verify operation of HVAC controls by performing the following tests:
   a. Verify that controller is maintaining the set point by manually measuring the controlled variable with a thermometer, sling psychrometer, inclined manometer, etc.
   b. Verify sensor/controller combination by manually measuring the controlled madium. Take readings from control panel, PC or portable operators terminal and compare readings taken manually. Record all readings.

      Sensor _____

      Manual measurement _____

      Panel reading value _____

   c. Verify system stability by changing the controller set point as follows:
      (1) Air temperature – 10 degrees F
      (2) Water temperature – 10 degrees F
      (3) Static pressure – 10 percent of set point
      (4) Relative humidity – percent (RH)

      The control system shall be observed for 10 minutes after the change in seat point. instability or excessive hunting will be unacceptable.
   d. Verify interlock with other HVAC controls.
   e. Verify interlock with fire alarm control panel
   f. Verify interlock with BAS
   g. Change controller set pint 10 percent with BAS and verify correct response.
2. Verify that operation of control system conforms to each specified sequence of operation.
3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Commissioning Authority _____

Contractor's Technical Supervisor _____

PVF – HVAC Controls (Continued)

For HVAC System _____:

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contractor's Officer's Representative _____

Using Agency's Representative _____

Design Professional's Representative _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this Section of the specifications.

Signature and Date

Commissioning Authority _____

Contractor's Technical Supervisor _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Emergency Generator Manufacturer's Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Design Professional's Representative _____

PVF – Radiation

1. PVT: Contractor shall demonstration operation of radiation as follows:

   a. Verify hot water flow in system
   b. Verify control valve operation by changing heating set point to heating set point – 10 F and return to heating set point.
   c. Verify warm air flow through radiation when control valve is open

   3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this Section of the specifications.

Signature and Date

Commissioning Authority _____

Contractor's Technical Supervisor _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Emergency Generator Manufacturer's Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Design Professional's Representative _____

SECTION 16113A

UNDERFLOOR DUCT SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 68Connection of Terminal Equipment to the Telephone Network

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WD 1(1983; R 1989) General Requirements for Wiring Devices

NEMA WD 6(1988) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 498(1996; Rev thru Sep 1998) Attachment Plugs and Receptacles

UL 870(1995) Wireways, Auxiliary Gutters, and Associated Fittings

UL 884(1998) Underfloor Raceways and Fittings

UL 1863(1995; R Oct 1998)Communication Circuit Accessories

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Duct System; G, RE

Detail drawings consisting of accurate and complete drawings as required to demonstrate compliance with the applicable provisions of the contract. Drawings shall clearly show the proposed layout of the duct system, including associated conduits and wireways. Drawings shall show connections to equipment or equipment cabinets, panelboards, and related components. Drawing shall be accurately scaled or dimensioned to indicate the proposed layout of the system, construction features of the facility or building, and equipment to be installed which would impact the layout or usage of the duct system. The layout shall ensure the clearances required for the proper operation, maintenance, and use of the system and facility equipment. Details shall be shown to indicate the manufacturer's proposed method of anchorage, leveling, mating and other details of the system, including appurtenances. The exact location of blank ducts, duct markers, inserts, junction boxes, cover plates, service fittings, conduits, wire troughs, and panelboards shall be shown. Each separate item proposed shall be identified by the corresponding item number used on the list of equipment and materials. Distinction shall be made between active, blank, future, or spare features of the duct system.

Detailed Drawings; G, RE

As-built drawings showing features of the complete duct system installed per the approved initial drawings, within 30 calendar days following the completed installation. Any deviations from previously approved drawings shall be indicated on the transmittal form or attachment thereto.

SD-03 Product Data

Components; G, RE
Insert Duct; G, RE
Blank Ducts; G, RE
Service Outlet Fittings; G, RE

Data published by the manufacturer to permit verification of the accuracy and completeness of information shown, and that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements of these specifications. Approval will be based on published literature of the manufacturer, or a certification of compliance issued by the manufacturer as evidence of compliance with these provisions.

Duct System; G, RE

Instructions showing the assembly and installation of ducts and duct components, approved prior to beginning any installation work.

Equipment and Materials; G, RE

A complete itemized listing of individual items of equipment and material proposed for incorporation into the work. Each itemization shall include an item number, the quantity of items required or proposed, the name of the manufacturer of each item, the catalog number or similar ordering information, and the nomenclature shown on published literature of the manufacturer.

SD-04 Samples

Service Outlet Fittings; G, RE

Physical examples of proposed equipment

SD-10 Operation and Maintenance Data

Duct System;

Six copies of instruction manuals, concurrently with the installation drawings, including specific instructions for locating and installing inserts of the preset and afterset types. Manuals shall include a list of recommended spare parts, a list of tools provided, and any other data or drawings required for the maintenance and future use of the duct system. Manuals shall be in suitable binders properly marked with pertinent contract information, containing dividers and indexes. Revised manuals or updated inserts, adjusted to show as-built conditions shall be furnished within 30 days after installation is complete.

1.3 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been incorporated into underfloor duct systems for at least 2 years prior to the bid opening.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials delivered prior to use shall be stored off the ground within a completely enclosed structure or shall be completely enclosed within a weatherproof covering. Material shall not be unpacked until needed for installation unless specific arrangements have been approved in advance. At time of final inspection of the building, material required to be delivered to the Contracting Officer shall be properly packaged, marked, and stored as directed.

1.5 TOOLS

One complete set of new tools for installing afterset inserts shall be provided. One electric or magnetic devices shall be provided for locating preset inserts. One set of tools for removing junction box covers shall be furnished.

1.6 SYSTEM DESCRIPTION

A complete underfloor raceway system including interface components shall be provided under this section. Service fittings shall be furnished with connectors unless otherwise noted. Wiring or cable, if required, will be furnished and installed under other sections of the specifications. Under this section, the wire or cable shall be extended into the fitting for connection to auditorium seating system. Power wiring shall be provided in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Communications wiring shall be provided in accordance with Section 16710 PREMISES DISTRIBUTION SYSTEM.

PART 2 PRODUCTS

2.1 COMPONENTS

A complete underfloor duct system shall be furnished. The system shall include blank and insert ducts, junction boxes, supports, elbows, offsets, expansion joints, outlets, conduit, conduit adaptors, connections, and necessary fittings to form a complete installation. Equipment and materials shall be products of a single manufacturer to the extent practicable.

2.1.1 Coordination - General Requirements

Layout and Contractor selections shall be fully coordinated with the architectural, structural, mechanical, and electrical work throughout all phases of this project including field modifications. The locations of duct shown on plans are intended to be approximate unless dimensions have been included; routings of feeders and interconnections are schematic. The overall configuration, relative proportions and general locations of devices should be maintained. Detailed drawings of the Contractor's proposed system shall be prepared as required under paragraph SUBMITTALS and shall include notes, dimensions, details or other means to show that interfacing with, or accommodation to, other work has been accomplished. Errors or conflicts encountered in the course of the project shall be brought promptly to the Contracting Officer's attention for resolution. When the products of more than one manufacturer will be utilized, the Contractor shall coordinate with the manufacturers to insure that the different products are compatible, that supplemental components are included if necessary, and that the products are installed per the manufacturer's prescribed procedures.

2.1.2 Architectural Considerations

Exposed portions of the system such as junction box covers shall have finish treatments or lay-in materials compatible with the architectural features of the surrounding surfaces. Accessories necessary to accommodate specific finished floor configurations shall be selected and installed in accordance with the recommendations and instructions of the manufacturer. Modifications of standard products, if required, shall be performed by or approved by the manufacturer.

2.2 SYSTEM TYPE

System shall be single level type, and shall consist of single, double, or triple duct as indicated. Duct system shall be located in the structural slab and shall comply with the requirements of UL 884.

2.3 DUCTS - GENERAL

Internal cross section shall be not less than 3 square inches for standard ducts and not less than 8 square inches for larger ducts shown. Minimum thickness shall be in accordance with Table 5.1 of UL 884. Duct shall be corrosion protected by a coating of zinc or equivalent enamel or organic paint.

2.4 INSERT DUCTS

Ducts shall have preset inserts located to suit the placement and connection of the auditorium seating system. Coordinate placement with the seating system installer.

2.5 BLANK DUCTS

Blank duct (no insert) may be used in lieu of insert duct in permanent corridors, vestibules, passageways, lobbies, and for connecting ducts between parallel ducts less than 6 feet (center-to-center), and as feeders from the equipment closet or wire cabinet to the first junction box.

2.6 JUNCTION BOXES

Junction boxes shall be of proper size to accommodate the various sizes and number of ducts shown. Single-level junction boxes shall have partitions to isolate the various services, and shall afford access to each compartment through a single handhole. Two-level junction boxes shall be independent and separate for each service, and shall permit feeder ducts to cross under distribution ducts.

2.6.1 Cover Plates

Cover plates shall be adjustable before and after concrete is placed. Plates and inner adjusting rings shall be readily removable. Junction boxes in finished areas shall be supplied with adapters or separate holders of a type to receive the architectural floor finish material.

2.6.2 Conduit Connections

Provision shall be made at corners or in the bottom of junction boxes to attach conduit where conduit connection is required.

2.7 SERVICE OUTLET FITTINGS

Surface-mounted service outlet fittings shall be made of corrosion-resistant metal with a satin finish. Fittings shall be not more than 3 inches high and shall be the single service types. Flush-mounted service fittings shall be corrosion- resistant metal or gray polycarbonate and have hinged covers. All service outlet fittings shall be products of a single manufacturer and shall be the manufacturer's standard item. The Contractor shall ensure that the size and orientation of an installed fitting will not interfere with the installation or use of a second outlet fitting located opposite on an adjacent raceway. Outlet fittings shall have ample wiring space to accommodate the quantity of conductors installed at each outlet.

2.7.1 Telephone Outlet Fittings

Outlet fittings for telephone service shall be of a type approved by the Contracting Officer and shall be provided in one or more of the following configurations: bushed opening or cable connector.

2.7.1.1 Bushed-Type Fittings

Fittings shall be of the same design as receptacle service fittings, but with a single bushed opening faced so that conductors will exit the bushing in a horizontal plane. Capacity must be adequate number of cables indicated.

2.7.2 Power Service Fittings

Power service fittings shall be suitable for flexible conduit (hard-wire) connection of auditorium seating. Coordinate with seating installer.

2.7.3 Special Power Outlet Fittings

Special outlet fittings shall have receptacles conforming to UL 498 with ratings as shown.

PART 3 EXECUTION

3.1 DUCT SYSTEM

Quantity, sizes, and arrangement of ducts and accessories shall be as shown on the plans. Separate ducts shall be provided for power and data services. Revisions implemented during construction shall be incorporated into the as-built installation drawings.

3.1.1 Ducts

Ducts shall be accurately aligned and leveled. The distance between the top of ducts and the finished concrete floor shall be as indicated. Duct joints shall prevent entry of concrete or fill. Where fixed dimensions are not indicated, ducts shall be installed in approximate locations shown. Junction boxes and duct lines shall be located to clear

permanent and future nonpermanent partitions and foundations for equipment and shall be coordinated with architectural modules. Unless otherwise indicated, ducts located in structural slabs shall be positioned outside the compression zone of the slab. Duct system installation shall comply with the requirements of NFPA 70.

3.1.2 Duct Supports

Metal duct supports shall be located as close as practicable to duct joints, elbows, bends, terminations; and within 30 inches on each side of junction boxes and elsewhere at intervals of not over 5 feet.

3.1.3 Inserts

Insert height shall be such that top of insert shall be l/8 inch below top of finished concrete sub-floor. Inserts closest to junction boxes shall be not more than 12 inches from vertical faces of junction boxes. Inserts shall be aligned on the same centers for all services and for duct rows in bays.

3.1.4 Termination

Ducts for power service shall terminate in bottom of panelboards or wire troughs with approved type fittings. Ducts for telephone service shall terminate 2 inches above the floor. Ducts shall be extended into telephone cabinets where required.

3.2 JUNCTION BOXES

3.2.1 Cover Plates

Cover plates shall be leveled flush with finished floor. Square or rectangular plates shall be laid square with wall lines. Coordinate plate and trim with the architectural floor finish schedule.

3.2.2 Protection

Duct terminations, boxes, plates, and rings shall be protected from damage, distortion, and entry of concrete. Exposed surfaces in finished work areas that are marred during placing of the floor shall be replaced with new items or finished equal to the original. Unused duct or conduit entrances to junction boxes shall be closed with blank closure plates or plugs. Sealant shall be placed on contact surfaces, such as at duct termination and other similar locations, to eliminate entry of concrete or fill material. Boxes shall be held in place, and securely supported during placement of concrete.

3.2.3 Conduit Connections

Conduit shall run below duct wherever necessary to cross a duct run. Conduit extensions shall enter junction boxes at corner, or bottom openings, or at spare duct openings through duct adapters.

3.3 DUCT MARKERS

Corrosion-resistant marker screws shall be installed flush with the architectural floor-finish material and shall be used as inserts at the following locations:

a. In each insert adjacent to a junction box.

b. In the last insert in each run of duct.

c. On both sides of permanent partitions.

d. At changes of direction of duct runs.

3.4 SERVICE OUTLET FITTINGS

3.4.1 Quantity and Location

Service fittings of the type indicated shall be installed at the location shown on the plans.

3.4.2 Cutting of Floors

Necessary cutting of floor for the installation of service fittings shall be made as recommended by duct system manufacturer. Floor construction or finish damaged by installation of fittings shall be patched or replaced.

3.4.3 Surplus Fittings

Spare fittings shall be furnished to the Contracting Officer in the following percentages of the total installed of each type:

Service	Type of Fitting	Percent
Telephone	Bushed Opening	10
Signal	Connector or Bushed Opening	10
Power	Connector or Opening	10

3.5 WIRE TROUGHS

Wire troughs shall be provided where indicated for connections between panelboard and underfloor duct.

3.6 BOUNDARIES

3.6.2 Walls

Stub ends of underfloor ducts perpendicular to walls shall be extended as close as practicable to wall line.

3.6.3 Expansion Joints

Expansion joints fittings shall be installed wherever floor duct or trench duct crosses building expansion joints. A bonding strap shall be included to insure ground continuity.

3.7 INSPECTION

Upon completion of the assembly of the underfloor duct system, and before ducts are covered, inspection in the presence of the Contracting Officer shall show ducts, boxes, and other related equipment to be in place. Entire system shall be free of obstructions and moisture after placing concrete. Ducts shall be thoroughly swabbed out before floor finish is applied and wiring is installed.

--End of Section--